HIGHLIGHTS

REVISION NO. 33 Jun 01/10

Pages which have been revised are outlined below, together with the Highlights of the Revision

CH/SE/SU PAGES	C	REASON FOR CHANGE	EFFECTIVITY
CHAPTER 34			
L.E.P. 1-13		Revised to Reflect this revision indicating new,revised, and/or deleted pages	
T. OF C. 2- 15		Revised to reflect this revision	
34-10-00 301- 302, 305- 311		Minor additions and amplification **DELETED TEXT.**	
34-10-00 504, 506, 508- 558		Effectivity updated at the bottom of the page Minor additions and amplification **MODIFIED TITLE IN ACCORDANCE WITH MPD TASK 341222-01-1.** Reprinted	
34-36-41 403		Minor additions and amplification **MODIFIED TEXT.**	
34-42-11 701- 703		New Topic/New Configuration Mod.0001X0057 incorporated **TECHNICAL PUBLICATION-BASIC MODIFICATION.** Mod.0001X0567 incorporated **TECHNICAL PUBLICATION-BASIC MODIFICATION.** SIL34-0099 incorporated **SCHEDULED MAINTENANCE TASK RECOMMENDATION FOR RADIO ALTIMETER ANTENNAS EXTERNAL SURFACE CLEANING**	
34-48-00 02 1- 5, 43-A 10		Effectivity updated at the bottom of the page Minor additions and amplification **MODIFIED TEXT.** Reprinted	
34-48-00 301- 302, 304		Mod.4803S5726 incorporated **EQUIPMENT/FURNISHINGS - FLIGHT COMPARTMENT - MODIFY DESIGN** SB 34-2188 01 incorporated **NAVIGATION - EGPWS - INSTALL ENHANCED GPWS HO**	

CH/SE/SU C PAGES	REASON FOR CHANGE	EFFECTIVITY
	NEYWELL PN 965-1676-001	
34-48-00 02 513	Layout Improved or Effectivity Updated	
34-51-11 401- 403	Minor additions and amplification UPDATED THE TABLES FOR EQUIPMENT AND MATERIALS AND FOR CIRCUIT BREAKERS	
34-52-00 1, 15	Reprinted DELETED TEXT	
34-52-00 535- 547	Effectivity updated at the bottom of the page Minor additions and amplification MODIFIED CHRONOLOGICAL SEQUENCE. Reprinted	

CHAPTER 34

NAVIGATION

LIST OF EFFECTIVE PAGES

N, R or D indicates pages which are New, Revised or Deleted respectively
Remove and insert the affected pages and complete the Record of Revisions and the Record of Temporary Revisions as necessary

CH/SE/SU	C	PAGE	DATE
RECORD OF TEMP. REVISION			
L.E.P.	R	1-13	Jun01/10
T. of C.		1	Jun01/08
T. of C.	R	2	Jun01/10
T. of C.	R	3	Jun01/10
T. of C.	R	4	Jun01/10
T. of C.	R	5	Jun01/10
T. of C.	R	6	Jun01/10
T. of C.	R	7	Jun01/10
T. of C.	R	8	Jun01/10
T. of C.	R	9	Jun01/10
T. of C.	R	10	Jun01/10
T. of C.	R	11	Jun01/10
T. of C.	R	12	Jun01/10
T. of C.	R	13	Jun01/10
T. of C.	R	14	Jun01/10
T. of C.	N	15	Jun01/10
34-00-00		1	Jun01/09
34-00-00		2	Dec01/90
34-00-00		3	Dec01/96
34-00-00		4	Dec01/96
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34-00-00		6	Jun01/04
34-00-00		7	Jun01/92
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34-10-00		503	Jun01/08
34-10-00	R	504	Jun01/10

Printed in France

CH/SE/SU	C	PAGE	DATE
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34-11-18	02	402	Dec01/06
34-11-18	02	403	Dec01/06
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34-20-00		93	Dec01/06

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34-48-00 02	R	72	Jun01/10	34-48-00 01		506	Jun01/06	34-51-00		12	Jun01/04
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BITE Test of IRS3 and IRS Switching			505	ALL
Test of Warnings			507	ALL
Test of Lighting and Display			509	ALL
Test of Attitude Comparison Warning			509	ALL
INERTIAL SENSOR DISPLAY UNIT (311FP)	34-25-14			
Removal/Installation			401	ALL
Deactivation/Reactivation			901	ALL
Deactivation			901	ALL
MODE SELECTOR UNIT (310FP1, 310FP2, 310FP3)	34-25-25			
Removal/Installation			401	ALL
INERTIAL REFERENCE UNIT (301FP1, 301FP2, 301FP3)	34-25-34			
Removal/Installation			401	ALL
INERTIAL REFERENCE UNIT MOUNT	34-25-37			
Adjustment/Test			501	ALL
STANDBY HORIZON	34-27-00			
Adjustment/Test			501	ALL
Operational Test			501	ALL
Functional Test			502	ALL
System Test			502	ALL
STANDBY HORIZON INDICATOR (25FN1)	34-27-21			
Removal/Installation			401	ALL
STANDBY COMPASS	34-28-00			
Adjustment/Test			501	ALL
Compensation Adjustment			501	ALL
Operational Test			505	ALL
Functional Test			505	ALL
System Test			506	ALL
Demagnetizing Procedure			506	ALL
STANDBY COMPASS (31FN)	34-28-21			
Removal/Installation			401	ALL
Removal/Installation of Standby Compass			401	ALL
Removal/Installation of Standby Compass Lamp			401	ALL
VOR/DME RMI (10FN1, 10FN2)	34-29-22			
Removal/Installation			401	ALL
ADF RMI (24FN1 - 24FN2)	34-29-23			
Removal/Installation			401	ALL

SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
MARKER BEACON SYSTEM	34-33-00			
Description and Operation			1	ALL
General			1	ALL
Component Location			1	ALL
System Description			4	ALL
Component Description			9	001-100,
Component Description			9	101-200,
System Operation			17	ALL
Test			19	001-100,
Test			19	101-200,
Adjustment Test			501	ALL
Operational Test			501	ALL
Functional Test			503	ALL
MARKER ANTENNA	34-33-13			
Removal/Installation			401	ALL
ILS	34-36-00			
Description and Operation			1	ALL
General			1	ALL
System Power Supply			7	ALL
Utilization Technical Data			8	ALL
Data Display			8	ALL
Utilization			13	ALL
Tests			22	ALL
Outputs			23	ALL
Face of ILS Receiver			23	001-100,
Face of ILS Receiver			23	101-200,
Adjustment/Test			501	ALL
Operational Test			501	ALL
Functional Test			504	ALL
LOCALIZER 1 AND 2 ANTENNA (3RT)	34-36-11			
Removal/Installation			401	ALL
ILS CONTROL BOX (34RT)	34-36-15			
Removal/Installation			401	ALL
ILS RECEIVER (1RT1, 1RT2)	34-36-31			
Removal/Installation			401	ALL
GLIDE ANTENNA (4RT)	34-36-41			
Removal/Installation			401	ALL
WEATHER RADAR	34-41-00			
Description and Operation			1	ALL
General			1	ALL
Component Location			1	ALL
System Description			8	ALL
Weather Radar System Components			8	001-100,
Weather Radar System Components			15	101-200,
Weather Radar System Peripherals			15	ALL
Component Description			16	ALL
Transceiver (1SQ1, 1SQ2)			16	ALL
Radar Control Box			42	ALL
Antenna Flat Plate			46	ALL
Antenna Dual Drive Unit			48	ALL
Wave Guide Assembly			58	001-100,

SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
Wave Guide Assembly			62	101-200,
Transceiver Shockmount			62	ALL
System Operation			67	001-100,
System Operation			67	101-200,
Test			79	ALL
System Test			79	ALL
Built-in Test			79	ALL
Interfaces			81	ALL
Adjustment/Test			501	ALL
System Test			506	001-100,
System Test			507	101-200,
Fctional Test of the Tilt Control			513	ALL
Fo the Weather Radar Antenna				
Dl Drive				
WEATHER RADAR ANTENNA ASSEMBLY (4SQ AND 28SQ)	34-41-11			
Removal/Installation			401	ALL
RADAR CONTROL BOX 3SQ	34-41-12			
Removal/Installation			401	ALL
WAVEGUIDE ASSEMBLY (11SQ, 14SQ)	34-41-25			
Removal/Installation			401	ALL
WEATHER RADAR TRANSCEIVER (1SQ1)	34-41-33	01		
Removal/Installation			401	101-200,
WEATHER RADAR TRANSCEIVER (1SQ1/1SQ2)	34-41-33	02		
Removal/Installation			401	001-100,
RADIO ALTIMETER	34-42-00	01		
Description and Operation			1	001-100,
General			1	001-100,
Component Location			1	001-100,
System Description			4	001-100,
Component Description			4	001-100,
Overall System Operation			13	001-100,
Operation			20	001-100,
Interfaces			23	001-100,
RADIO ALTIMETER	34-42-00	02		
Description and Operation			1	101-200,
General			1	101-200,
Component Location			1	101-200,
System Description			1	101-200,
Overall System Operation			13	101-200,
Operation			18	101-200,
Interface			20	101-200,
RADIO ALTIMETER	34-42-00			
Adjustment/Test			501	ALL
Operational Test			501	ALL
Functional Test			503	ALL
System Test			503	ALL
RADIO ALTIMETER TRANSMISSION AND RECEPTION ANTENNA (4SA1, 4SA2, 5SA1, 5SA2)	34-42-11	01		
Removal/Installation			401	001-100,

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SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
RADIO ALTIMETER TRANSMISSION AND RECEPTION ANTENNA (4SA1, 4SA2, 5SA1, 5SA2)	34-42-11	02		
Removal/Installation			401	101-200,
ANTENNA - RADIO ALTIMETER (4SA1, 4SA2, 5SA1, 5SA2)	34-42-11			
Cleaning/Painting				
RADIO ALTIMETER TRANSCEIVER (1SA1, 1SA2)	34-42-33			
Removal/Installation			401	ALL
COOLING FAN 9SA1 (9SA2)	34-42-43			
Removal/Installation			401	ALL
Cleaning/Painting			701	ALL
AUTOMATIC CALL OUT	34-43-00			
Description and Operation			1	ALL
General			1	ALL
System Description			1	ALL
Functional Description			3	ALL
Operation			10	ALL
Adjustment/Test			501	ALL
Operational Test			501	ALL
Functional Test			503	ALL
TCAS	34-44-00			
Description and Operation			1	005-200,
General			1	005-200,
Component Location			2	005-200,
System Description			8	005-200,
Principle			8	005-200,
Advisories			8	005-200,
Display			8	005-200,
Coordination			11	005-200,
Power Supply			11	005-200,
Component Description			13	005-200,
TCAS Computer			13	005-200,
ATC/TCAS Control Unit			17	005-200,
Antennas			27	005-200,
VSI/TCAS Indicators			27	005-200,
ATC Mode S Transponders			29	005-200,
Peripherals			29	005-200,
Operation			35	101-200,
Operation			36	005-100,
Intruder Detection			36	005-200,
Intruder Parameters			45	005-200,
Coordination			48	005-200,
Principles of Computation			53	005-200,
Definition of Target Aircraft			57	005-200,
Sensitivity Level			65	005-100,
Sensitivity Level			66	101-200,
Display on VSI/TCAS Indicator			71	005-200,
Test			76	005-100,

SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
Self-Test			76	005-100,
Test			76	101-200,
Self-Test			76	101-200,
Failure Annunciation			78	005-200,
Extended Test Sequence			78	005-200,
TCAS Frame on TCAS-DISP ARINC 429 Bus			78	005-200,
Adjustment/Test			501	005-200,
Operational Test			501	005-100,
Operational Test			502	101-200,
Deactivation/Reactivation			901	005-100,
MMEL 34-76-01 (FAA only)			901	005-100,
TCAS Deactivation			901	005-100,
TCAS Reactivation			901	005-100,
TCAS ANTENNA	34-44-11			
Removal/Installation			401	005-200,
TCAS COMPUTER (1SG)	34-44-34			
Removal/Installation			401	005-200,
GROUND PROXIMITY WARNING SYSTEM	34-48-00 01			
Description and Operation			1	001-100,
General			1	001-100,
Component Location			1	001-100,
Description			1	001-100,
Component Description			3	001-100,
Operation			9	001-100,
ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)	34-48-00 02			
Description and Operation			1	101-200,
General			1	101-200,
Basic GPWS Modes			1	101-200,
Enhanced Features			2	101-200,
Additional Features			3	101-200,
Component Location			6	101-104,
Component Location			6	101-200,
Power Supply			12	101-200,
Description			14	101-104,
Description			14	101-200,
Component Description			25	101-200,
EGPWC			25	101-200,
GPWS-G/S Indicator Lights 3WZ, 4WZ			28	101-104,
PULL UP/GPWS Pushbutton Switches 3WZ,4WZ			30	101-200,
NORM/FLAP OVRD/OFF Switch 12WZ			30	101-200,
GPWS Annunciator 24WZ			31	101-200,
GPWS/LANDING/SLATS/FLAPS Switch 23WZ			31	101-200,
CAPT and F/O TERR Pushbutton Switches 30WZ1 and 30WZ2			34	101-200,
TERR MODE Pusbutton Switch 31WZ			34	101-200,
Operation			37	101-104,

	SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
	General			37	101-104,
	Detailed Operation - Modes 1 through 5			39	101-104,
	Operation			39	101-200,
	General			39	101-200,
	Detailed Operation - Modes 1 through 5			41	101-200,
R	Envelope Modulation			62	101-200,
	Enhanced Features			66	101-200,
	Warning Generation and Inhibition			99	101-104,
	Warning Generation and Inhibition			A001	101-200,
	Test			A004	101-104,
	Self-Tests			A004	101-104,
	Test			A005	101-200,
	Self-Tests			A005	101-200,
	ENHANCED GROUND PROXIMITY WARNING SYSTEM	34-48-00			
	Servicing			301	101-200,
R	Uploading of PCMCIA Card Database			301	101-200,
	GROUND PROXIMITY WARNING SYSTEM	34-48-00	01		
	Adjustment/Test			501	001-100,
	ENHANCED GROUND PROXIMITY WARNING SYSTEM	34-48-00	02		
	Adjustment/Test			501	101-200,
	GROUND PROXIMITY WARNING COMPUTER 1WZ	34-48-11			
	Removal/Installation			401	ALL
	DME	34-51-00			
	Description and Operation			1	ALL
	General			1	ALL
	Component Location			1	ALL
	System Description			8	ALL
	Component Description			13	001-100,
	Component Description			13	101-200,
	System Operation			26	ALL
	Test			33	001-100,
	Test			33	101-200,
	Adjustment/Test			501	ALL
	Operational Test			501	ALL
	Functional Test			503	ALL
	DME ANTENNA	34-51-11			
	Removal/Installation			401	ALL
	DME INTERROGATOR 1SD1 (1SD2)	34-51-33			
	Removal/Installation			401	ALL
	ATC	34-52-00			
	Description and Operation			1	ALL
	General			1	ALL
	System Description			8	ALL
	Component Description			13	ALL
	System Operation			18	001-003,101-200,
	System Operation			22	004-100,
	Test			23	101-200,

SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
Test			24	001-100,
Maintenance Practices			201	ALL
Adjustment/Test			501	ALL
Operational Test			501	ALL
Functional Test			503	ALL
Functional Test			527	ALL
Functional Test of Air Traffic Control (ATC) Mode S			535	ALL
ATC ANTENNA	34-52-11			
Removal/Installation			401	ALL
ATC CONTROL UNIT 4SH	34-52-13			
Removal/Installation			401	ALL
ATC TRANSPONDER 1SH1 (1SH2)	34-52-33			
Removal/Installation			401	ALL
ADF	34-53-00			
Description and Operation			1	ALL
General			1	ALL
Component Location			2	ALL
System Description			9	ALL
Component Description			23	101-200,
Component Description			26	001-100,
System Operation			37	ALL
Test			44	101-200,
Test			44	001-100,
Adjustment/Test			501	ALL
Operational Test			501	ALL
ADF LOOP AND SENSE ANTENNA	34-53-11			
Removal/Installation			401	ALL
ADF CONTROL UNIT (3RP2)	34-53-13			
Removal/Installation			401	ALL
ADF RECEIVER 1RP1 (1RP2)	34-53-31			
Removal/Installation			401	ALL
VOR	34-55-00			
Description and Operation			1	ALL
General			1	ALL
Component Location			1	ALL
System Description			9	ALL
Component Description			12	001-100,
Component Description			18	101-200,
System Operation			28	ALL
Test			33	001-100,
Test			37	101-200,
Adjustment/Test			501	ALL
Operational Test			501	ALL
Functional Test			504	ALL
VOR ANTENNA	34-55-11			
Removal/Installation			401	ALL
VOR/DME CONTROL UNIT 3RS1 (3RS2)	34-55-13			
Removal/Installation			401	ALL
VOR/MKR RECEIVER 301RS1 (301RS2)	34-55-31			

SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
Removal/Installation			401	ALL
FLIGHT MANAGEMENT SYSTEM	34-60-00			
Description and Operation			1	ALL
General			1	ALL
Component Location			2	ALL
System Description			5	ALL
Component Description			9	ALL
Flight Management Computer (FMC)			9	ALL
FMC Digital Data Inputs			20	ALL
Inertial Reference System (IRS)			20	ALL
Automatic Flight System (AFS)			22	ALL
Air Data Computer (ADC)			31	ALL
Electronic Flight Instrument System Control Panel (EFIS CP)			33	ALL
Distance Measuring Equipment (DME)			35	ALL
VHF Omni-Range (VOR)			37	ALL
Flight Augmentation Computer (FAC)			37	ALL
Instrument Landing System (ILS)			41	ALL
Digital Clock			41	ALL
Fuel Flow			41	ALL
Fuel Quantity (FQS)			41	ALL
Trim Tank Fuel Quantity			41	ALL
FMC Digital Outputs			46	ALL
Data Loaders			61	ALL
Control Display Unit (CDU)			64	ALL
Servicing			301	ALL
Adjustment/Test			501	ALL
Operational Test			501	ALL
FMS Test			501	ALL
Alignment of IRS1, 2 and 3 via CDUs through FMC1 (2)			503	ALL
FMS - POWER SUPPLY	34-61-00			
Description an Operation			1	ALL
Aircraft Power Supply			1	ALL
Primary Power (115VAC/400Hz)			1	ALL
CDU BRT/DIM (28VDC)			1	ALL
CDU Keyboard Lighting			1	ALL
Input Power Supply Characteristics			9	ALL
FMS OPERATIONAL USE	34-63-00			
Description and Operation			1	ALL
FMS Modes of Operation			1	ALL
Definitions			1	ALL
Master/Slave Concept			1	ALL
Dual Operation of CDUs Rules			4	ALL
Interfaces in Case of Independent Mode of Operation			5	ALL
Dual System Synchronization			6	ALL

SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
CDU OPERATIONAL USE			7	ALL
General			7	ALL
CDU Description			15	ALL
MODE page			68	ALL
STAR Selection Rules			A007	ALL
N F-PLN after insertion of HOLD			A019	ALL
Vertical F-PLN Structure			B041	ALL
FMS CDU (3CK1, 3CK2)	34-68-11			
Removal/Installation			401	ALL
FLIGHT MANAGEMENT COMPUTER (1CK1, 1CK2)	34-68-34			
Removal/Installation			401	ALL
ELECTRONIC INSTRUMENT DISPLAY	34-70-00			
Description and Operation			1	ALL
General			1	ALL
Component Location			2	ALL
Description			8	ALL
System Description			8	ALL
Power supply			8	ALL
Component Description			11	ALL
Symbol Generator Unit (SGUs : 28FN1, 28FN2, 28FN3)			11	ALL
Display Unit (34FN1, 34FN2, 36FN1, 36FN2)			17	ALL
EFIS Control Panel (42FN1, 42FN2)			22	ALL
Additional Panels			26	ALL
Operation			29	ALL
General			29	ALL
Operation on PFD			31	ALL
Mode annunciators			62	ALL
Operation on ND			71	ALL
ROSE mode			71	ALL
Interfaces			A006	ALL
General			A006	ALL
Symbol Generator Unit Interfaces			A006	ALL
EFIS - GENERAL	34-71-00			
Adjustment/Test			501	ALL
Operational Test			501	ALL
EFIS/INPUTS Test			504	ALL
EFIS/BITE test			509	ALL
EFIS Control Panel Test			513	ALL
Complementary navigation Control Panel Test			515	ALL
Switching Test			519	ALL
DISPLAY UNIT SWAPPING PROCEDURE (1WT, 3WT, 34FN1, 34FN2, 36FN1, 36FN2)	34-71-22			
Maintenance Practices			201	ALL
EFIS CONTROL PANEL (42FN1, 42FN2)	34-73-11			
Removal/Installation			401	ALL
EFIS SGU (28FN1, 28FN2, 28FN3)	34-73-34			

SUBJECT	CH/SE/SU	C	PAGE	EFFECTIVITY
Removal/Installation			401	ALL
PRIMARY FLIGHT DISPLAY 34FN1 (34FN2)	34-74-22			
Removal/Installation			401	ALL
Cleaning/Painting			701	ALL
NAVIGATION DISPLAY 36FN1 (36FN2)	34-75-22			
Removal/Installation			401	ALL
Cleaning/Painting			701	ALL

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1. General

The aircraft navigation systems provide the crew with the data required for flight within the most appropriate safety requirements
This data can be divided into seven groups :
- Flight environment data or "air data"
- Attitude and Direction
- Landing and Taxiing Aids
- Independent position determining
- Dependent position determining
- Position computing (optional)
- Electronic Instrument Display (EFIS).

2. Description and Operation

A. Flight Environment Data (Ref. 34-10)

Flight Environment Data for the A310 aircraft are provided by three independent systems :
- Two main systems

**ON A/C 001-003,

(Ref. Fig. 001)

**ON A/C 004-200,

(Ref. Fig. 002)

**ON A/C ALL

Each of these two systems includes Static probes, Pitot probes, Total Air Temperature probes and Alpha probes which provide the digital Air Data Computer (ADC) with the necessary data for the generation of parameters which are transmitted to the indicators and to the various aircraft systems.
- A standby system
(Ref. Fig. 003)
The standby system includes Pitot probe and Static probes which directly transmit pressure to the standby instruments.

More explanations are given in 34-10 which is divided as follows :
(1)General (Ref. : 34-10)
(2)ADS - Sensors - ADC - Power Supply (Ref. : 34-11)
(3)Altitude (Ref. : 34-12)
(4)Airspeed - Mach - VMO (Ref. : 34-13)
(5)Vertical Speed (Ref. : 34-14)
(6)TAS - SAT - TAT (Ref. : 34-15)
(7)Switching (Ref. 34-17).
(8)ADS Test (Ref. 34-18)

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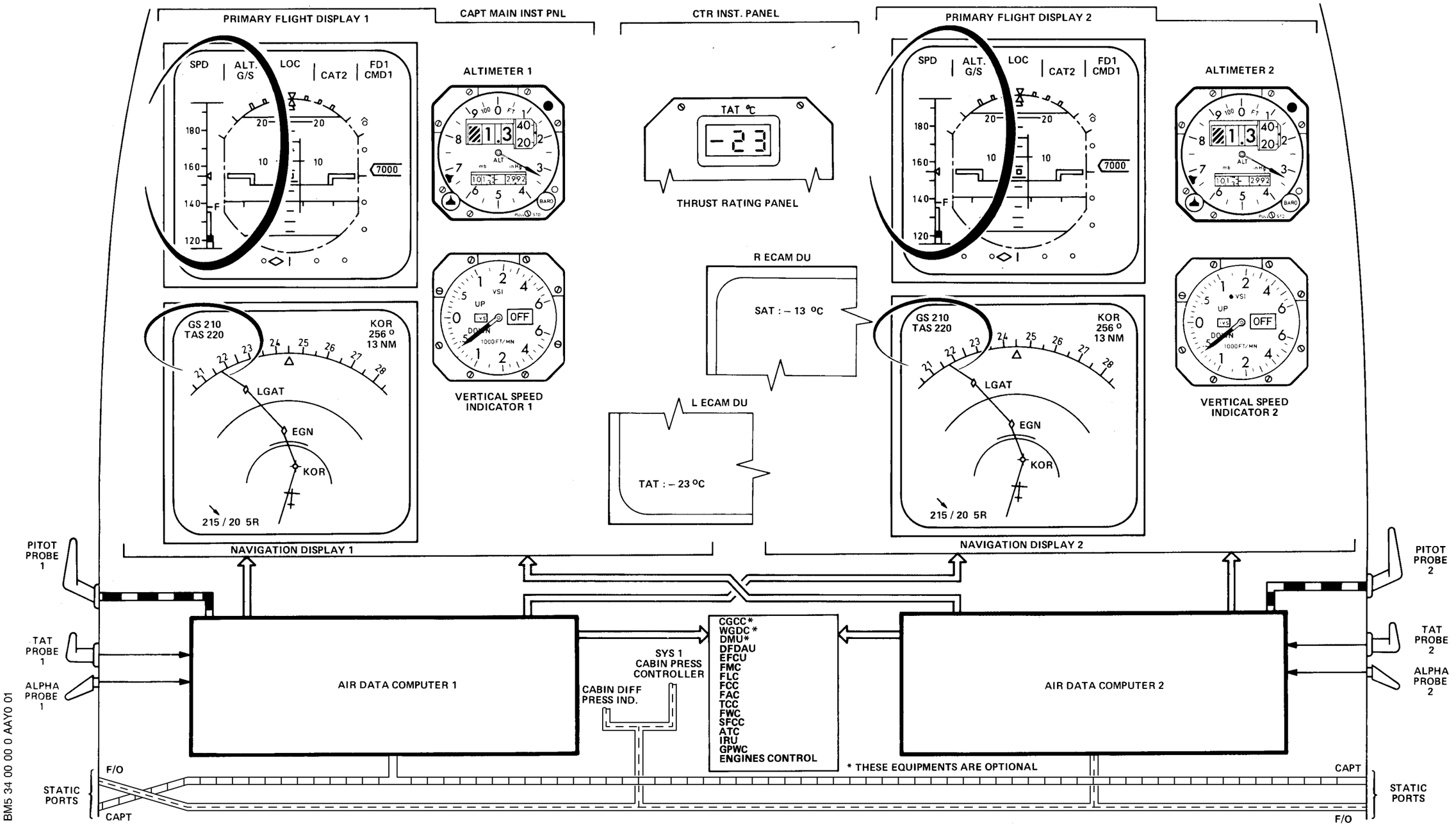
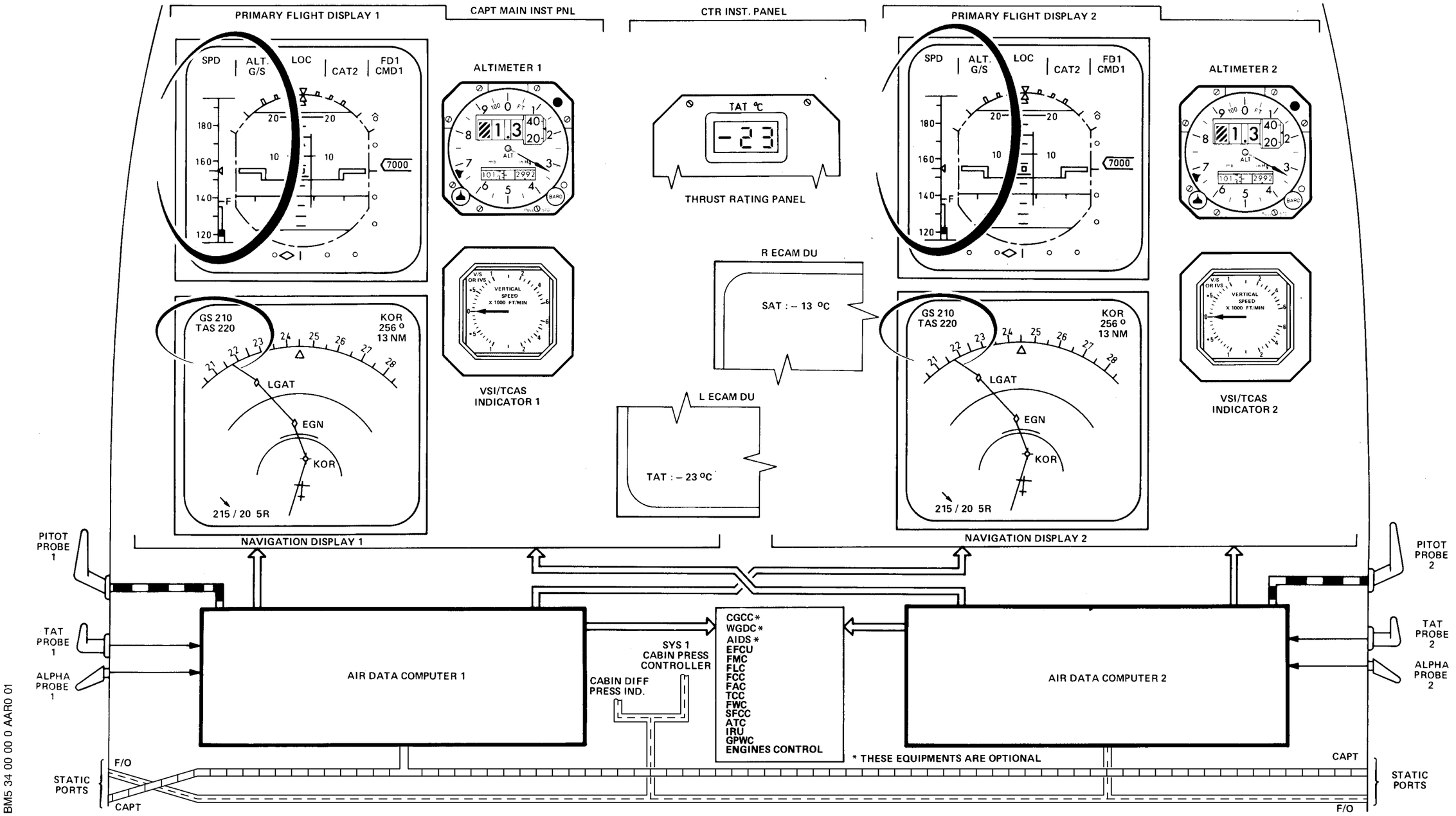
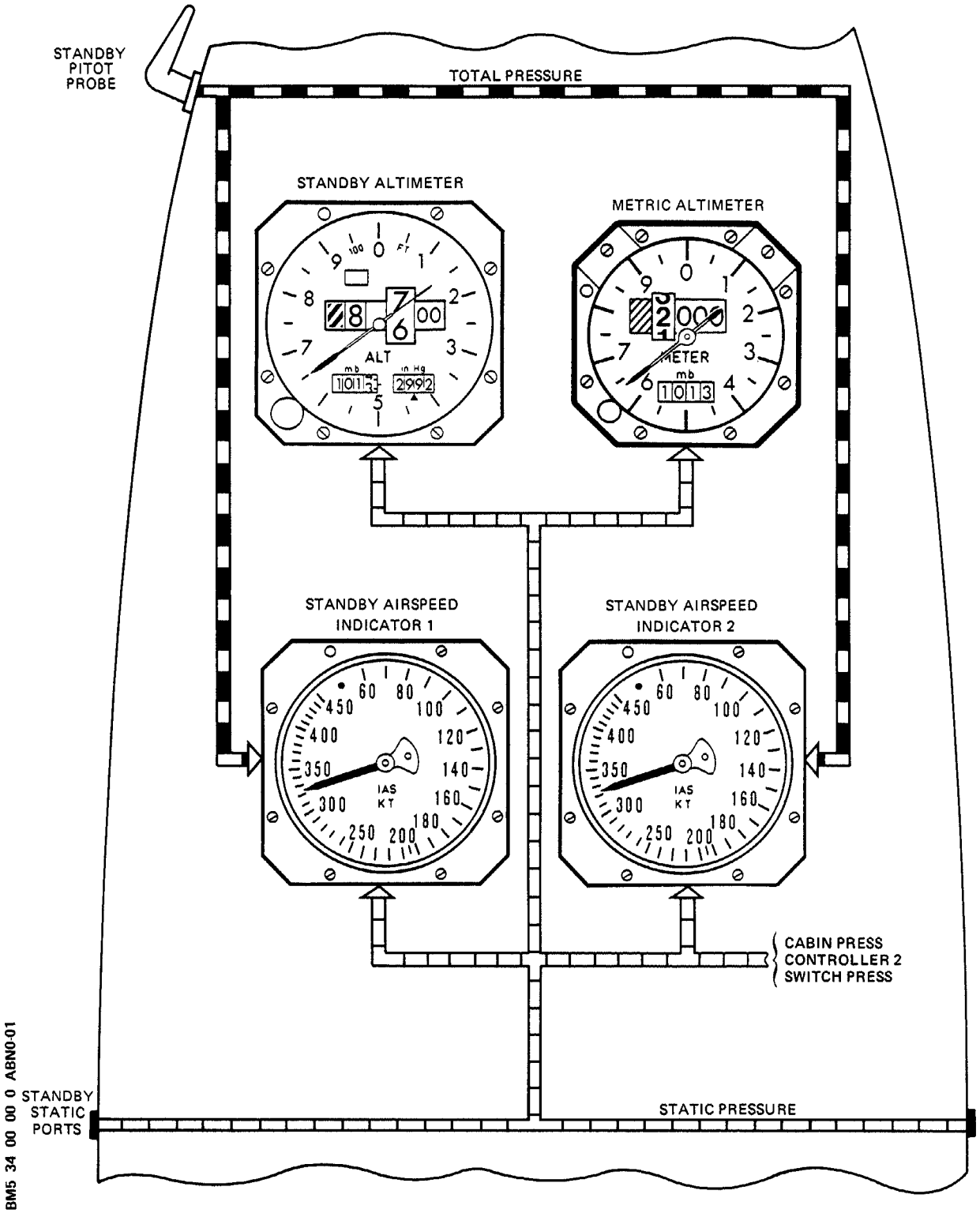


Normal Air Data System
Figure 001

R



Normal Air Data System
Figure 002



Standby Air Data System
Figure 003

B. Attitude and Direction (Ref. 34-20)
Attitude and Direction data are provided by four independent systems :
- Three main systems (IRS 1, 2 and 3)

**ON A/C 001-003,

(Ref. Fig. 004)

**ON A/C 004-004,

(Ref. Fig. 005)

R **ON A/C 005-200,

(Ref. Fig. 006)

**ON A/C ALL

The Inertial Reference System is complying with ARINC characteristic 704. The IRS is a strapdown inertial system. It provides inertial reference information, attitude, ground speed, present position.
The primary information of angular speed and linear acceleration measured by the IRS are directly used by the AFS systems (FAC - FCC - TCC).
The 3 systems are made up of the following components :
. 3 IRU (Inertial Reference Unit)
. 3 MSU (Mode Selector Unit)
. 1 ISDU (Inertial Sensor Display Unit)
The data are provided to the crew by :
. EFIS displays : two PFD's (Primary Flight Display) and
two ND's (Navigation Display)

**ON A/C 001-003,

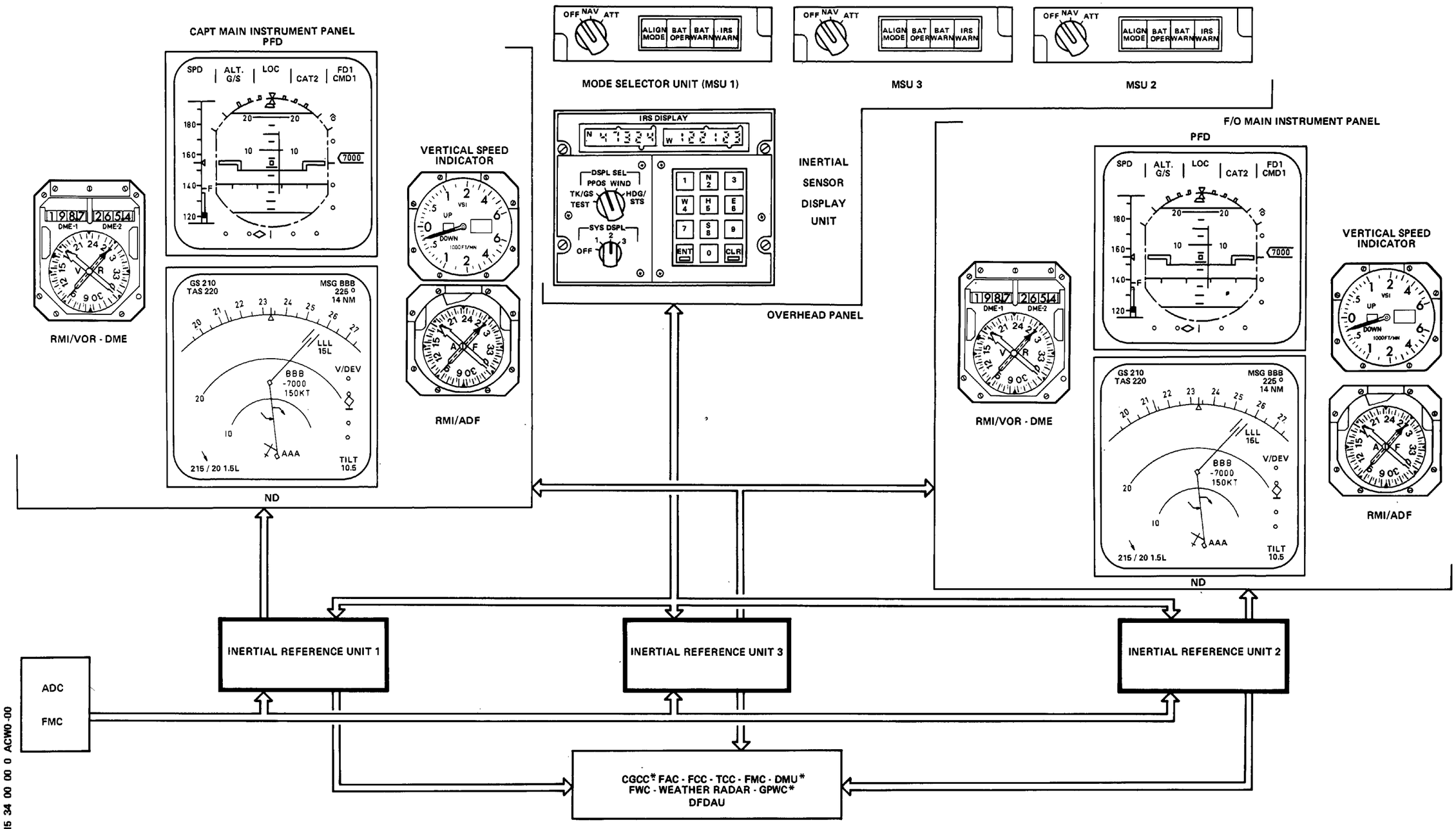
. two RMI/VOR-DME (Radio Magnetic Indicator/VOR-DME)
. two RMI/ADF (Radio Magnetic Indicator/ADF)
. two VSI (Vertical Speed Indicator)
- A standby system including :

R **ON A/C 004-200,

. two RMI/VOR-DME (Radio Magnetic Indicator/VOR-DME)
. two RMI/ADF (Radio Magnetic Indicator/ADF)
. two VSI/TCAS indicators (Vertical Speed Indicator/Traffic Collision Avoidance System).
- A standby system including :

**ON A/C ALL

(Ref. Fig. 007)
. a standby horizon
. a standby compass



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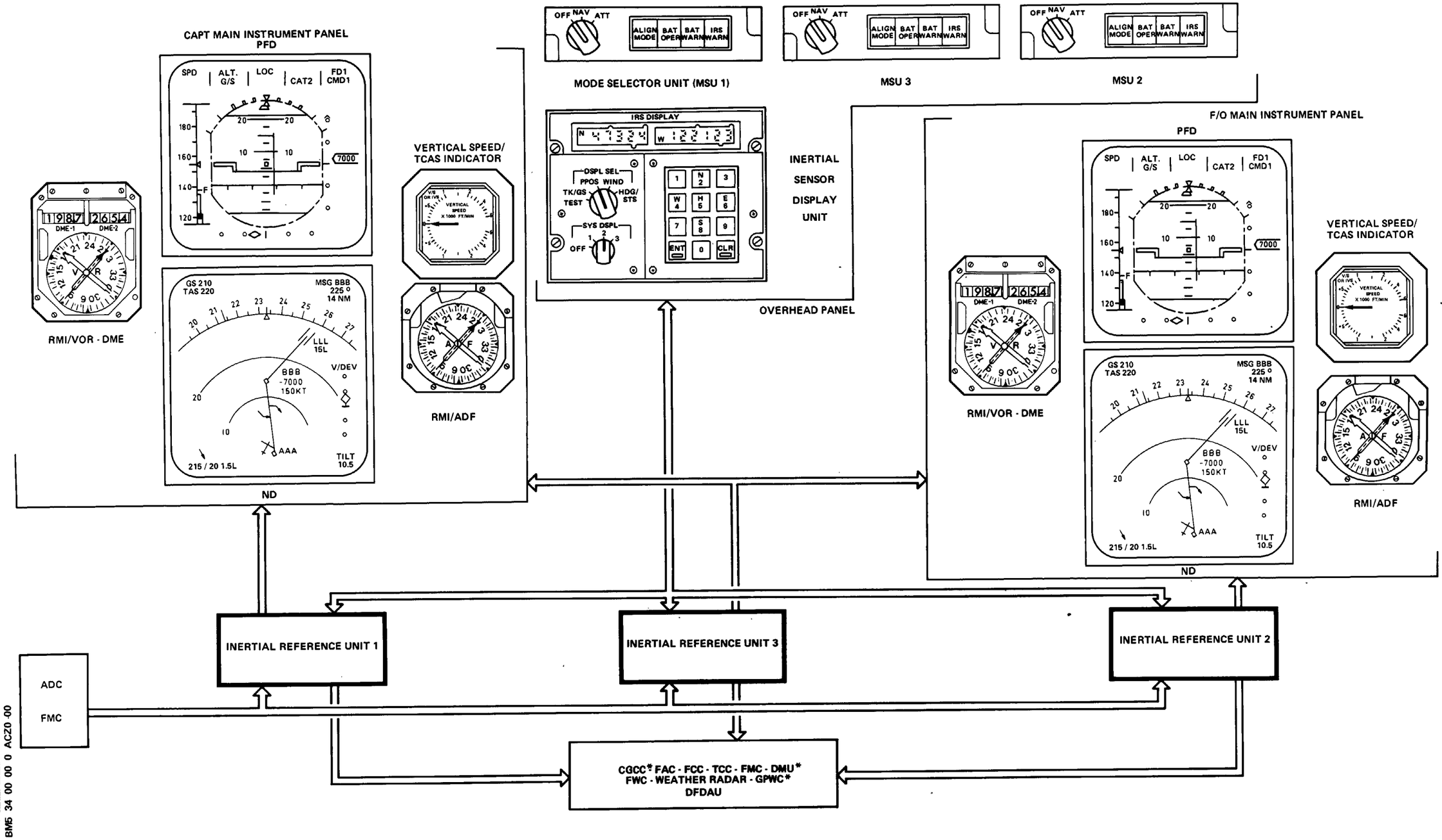
Inertial Reference Information
Figure 004



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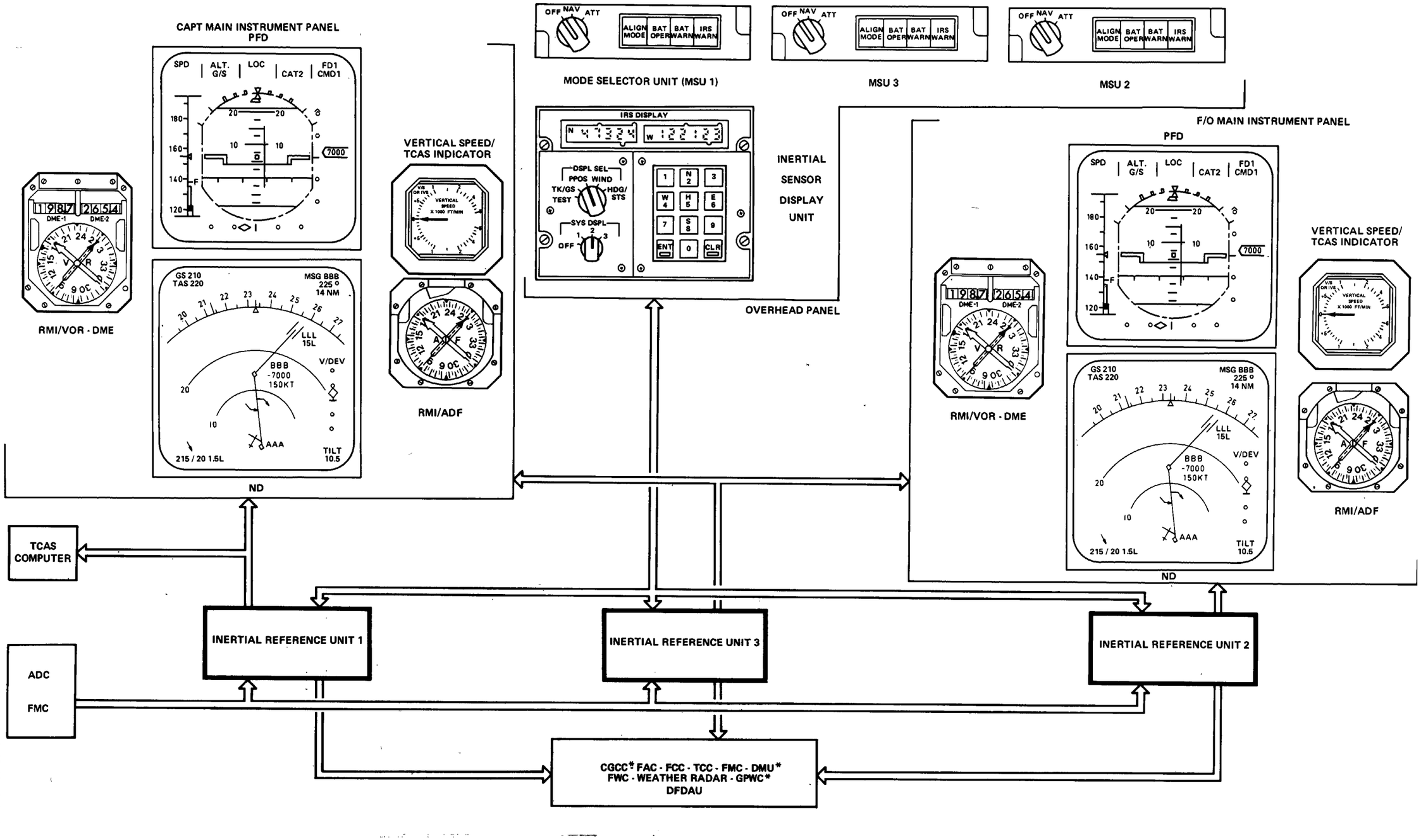
Inertial Reference Information
Figure 005



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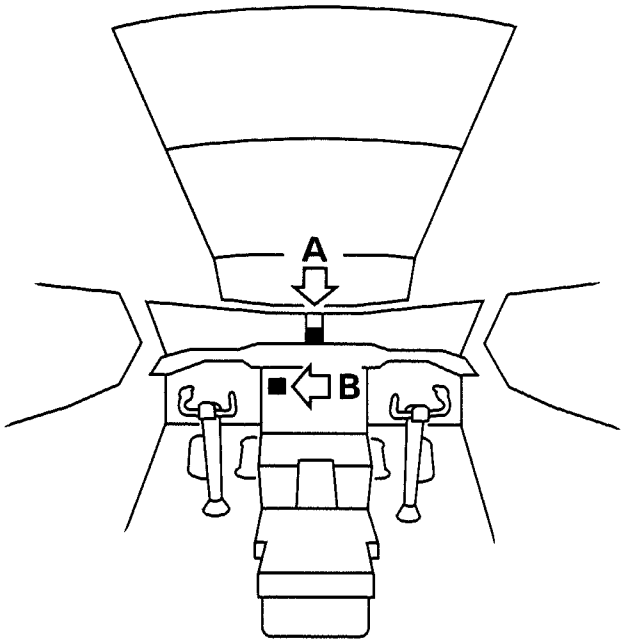
Inertial Reference Information
Figure 006



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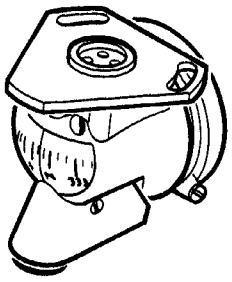
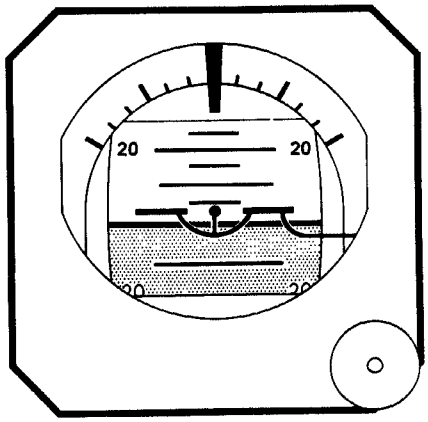


STANDBY COMPASS

B



STANDBY ATTITUDE REFERENCE INDICATOR

BM5 34 00 00 0 ADM0-01

Attitude and Direction - Standby System
Figure 007

More explanations are given in 34-20 which is divided as follows :
(1)General (Ref. : 34-20)
(2)Inertial Reference System (Ref. : 34-25)
(3)Attitude Information : Switching and Indicating (Ref. : 34-27)
(4)Heading Information : Switching and Indicating (Ref. : 34-28)
(5)Radio Magnetic Information : Switching and Indicating (Ref. : 34-29)

C. Landing and Taxiing Aids

This part of the navigation system comprises :

- a marker beacon system
  This enables the aircraft position to be known, during the landing phase with respect to the runway threshold and in flight with respect to known points on the ground.
- a Windshield Guidance Display System (WGDS) (Optional)
  The WGDS is used to display lateral guidance information during take-off and roll-out.
- two Instrument Landing Systems (ILS)
  This enables the aircraft position during the landing phase with respect to a predetermined descent path to be known.

(1)Marker Beacon System

(Ref. Fig. 008)

These are two digital VOR-MARKER receivers conforming to ARINC characteristic 711.

There is one MARKER antenna only to supply VOR/MKR 1 receiver which is the only one to ensure MARKER function.

VOR/MKR 1 receiver supplies both CAPT and F/O MKR indicator lights, when passing over each of the three beacons.

More explanations are given in 34-33.

(3)Instrument Landing System

**ON A/C 001-003,

(Ref. Fig. 009)

R **ON A/C 004-200,

(Ref. Fig. 010)

**ON A/C ALL

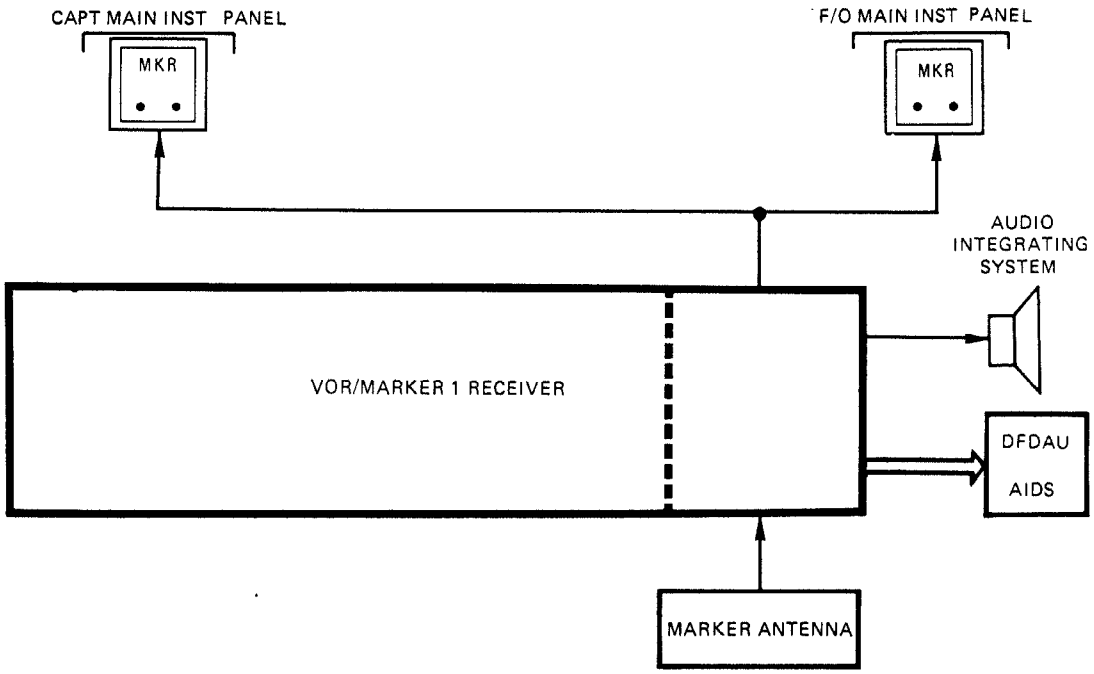
The ILS includes two systems controlled from a single control box featuring two output channels.

The aircraft is equipped with :

- 2 ILS receivers
- 1 ILS control box
- 1 LOCALIZER antenna
- 1 GLIDE SLOPE antenna

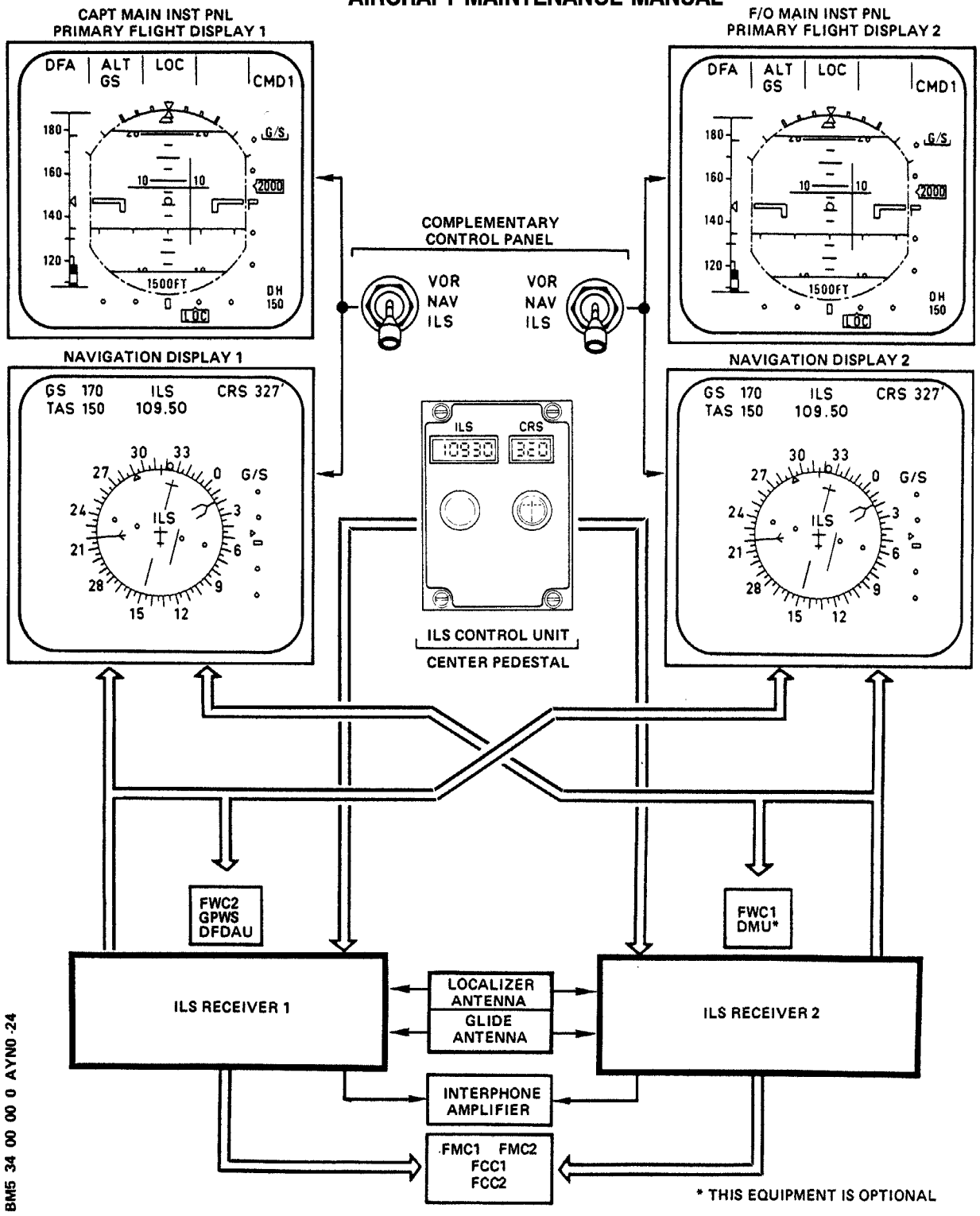
All the data are shown on the EFIS displays.

More explanations are given in 34-36.

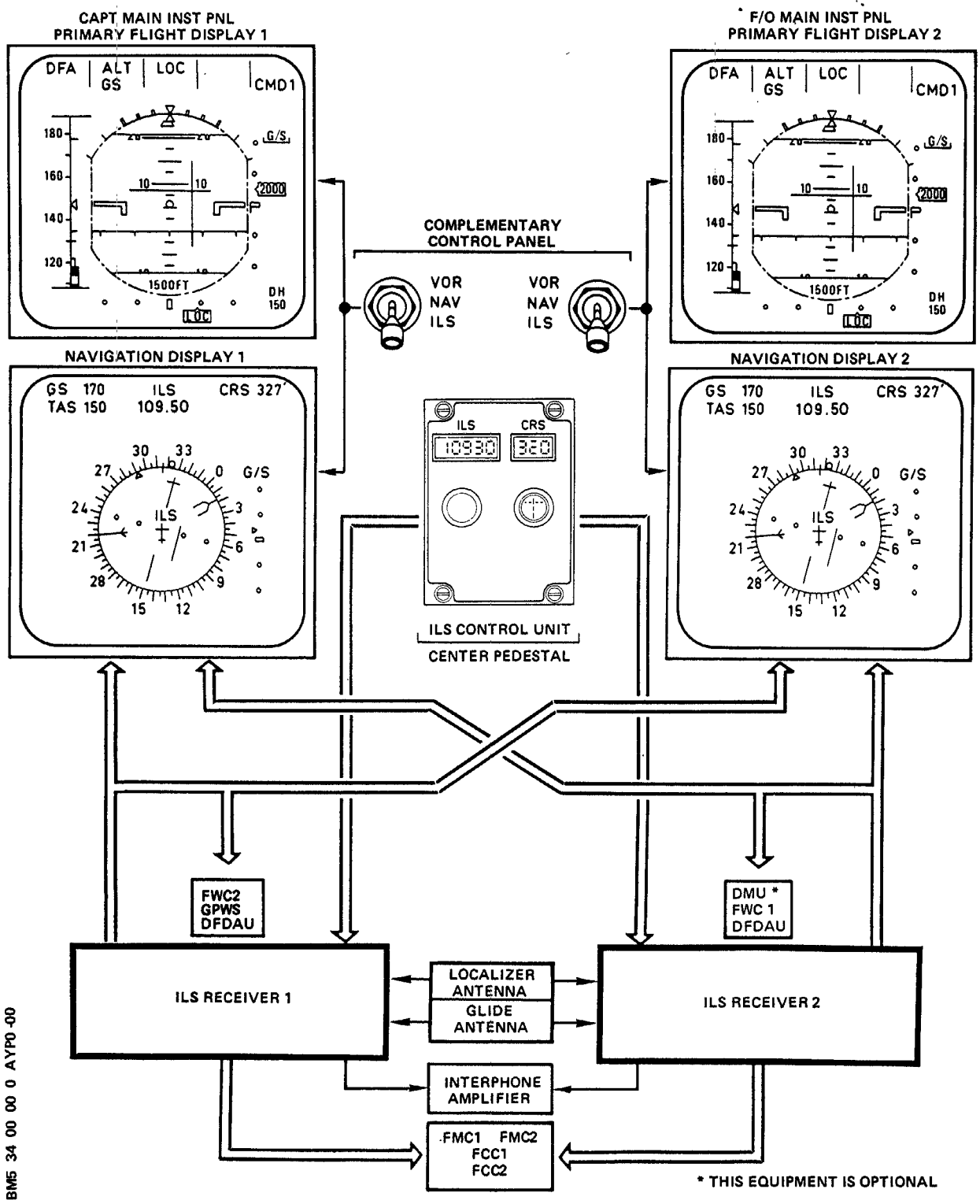


DM5 34 00 00 0 AEMO 02

Marker Beacon System
Figure 008



Instrument Landing System
Figure 009



Instrument Landing System
Figure 010

D. Radio Navigation Data Independent Position Determining
This part of the radio navigation system, which is basically independent of ground installations, provides data on the position of the aircraft. It comprises :
- weather radar system
  This enables detection and localization of atmospheric disturbances in the area swept by the antenna signal and provides visual display of their intensity.
- radio altimeter system
  This enables the aircraft height above the ground to be precisely and continuously determined, independently of the atmospheric pressure.
- automatic call-out system
  It enables automatic call out of the altitudes during the landing phases.

R **ON A/C 005-200,

- Traffic Collision Avoidance System
  It enables detection and display of aircraft in the immediate vicinity and provides the flight crew with advisories to avoid the intruders by changing the flight path in the vertical plane only.

**ON A/C ALL

- ground proximity warning system (optional)
  This is used to inform the crew if the aircraft is in a dangerous configuration when approaching the ground in a non-predetermined manner.

(1)Weather Radar System

R **ON A/C 101-200,

(Ref. Fig. 011)

R **ON A/C 001-100,

(Ref. Fig. 012)

R **ON A/C ALL

The aircraft is equipped with digital weather radar system in accordance with ARINC characteristic 708. The system is made up of the following components :
- One or two transceivers (full provision for a second transceiver is made).
- one control unit
- a flat plate antenna and its mount.

The EFIS controls the operation and superimposes the weather picture on the Navigation Display.
The system is connected to the IRS.
More explanations are given in 34-41.

(2)Radio altimeter

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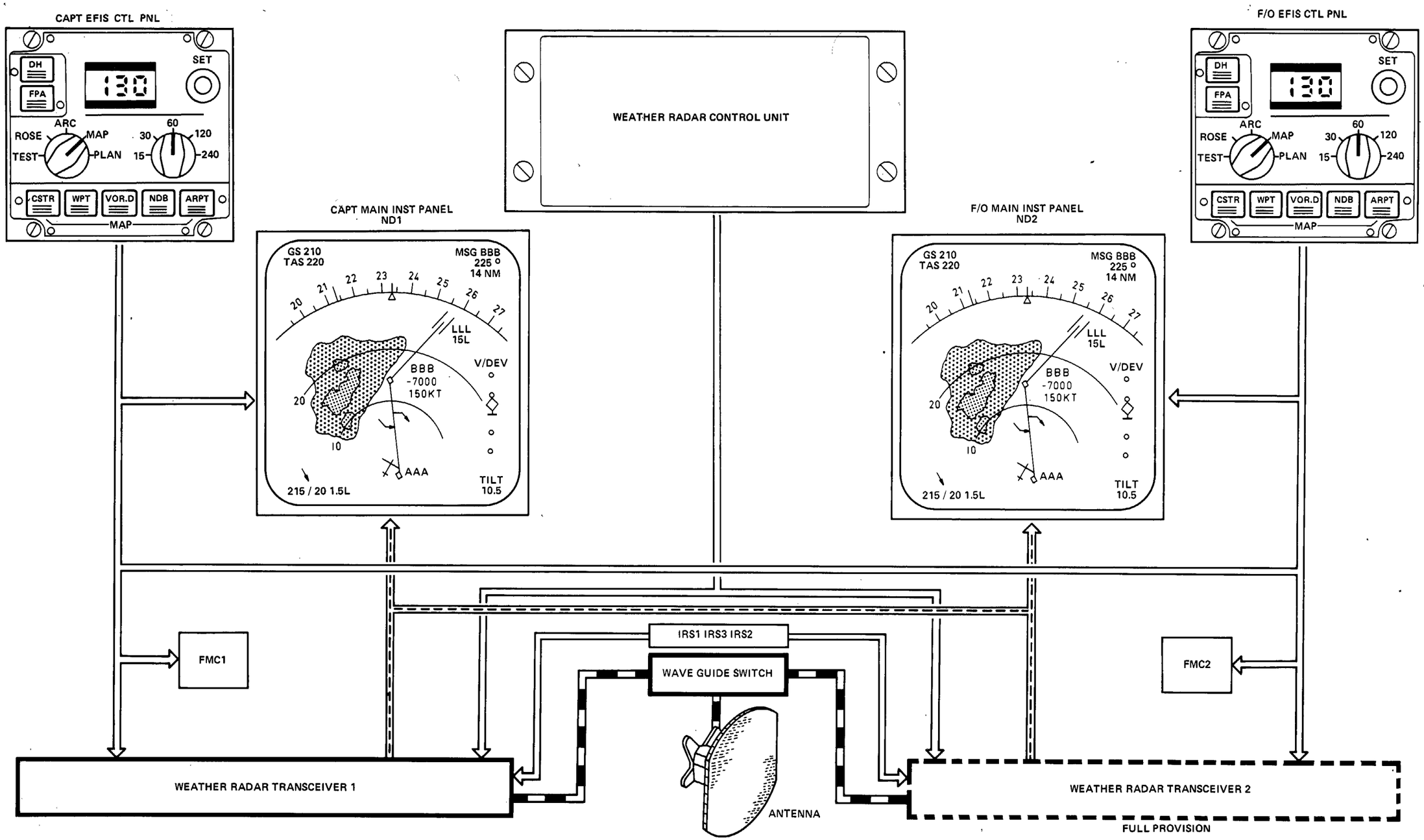
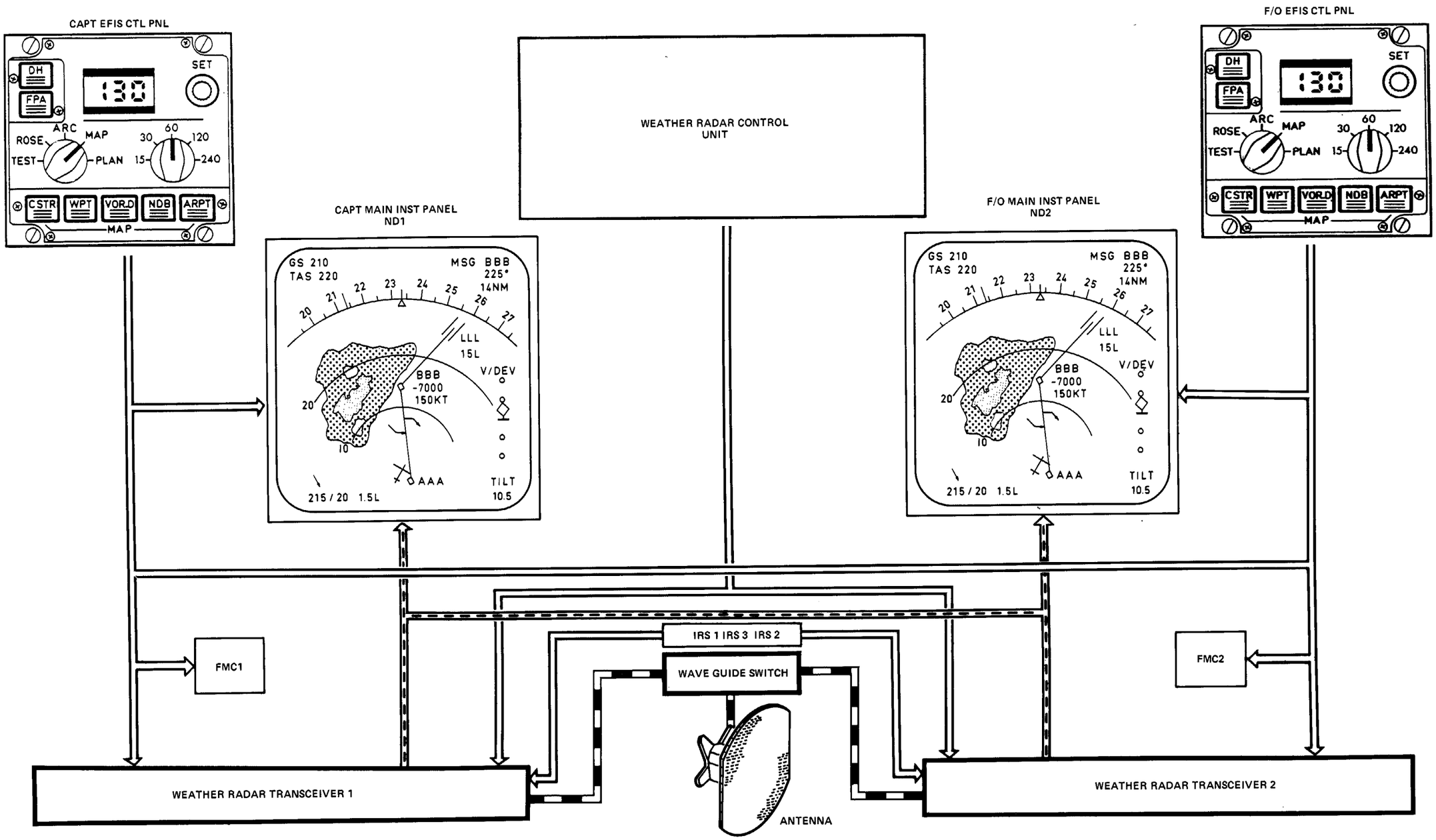


IBM5 34 00 00 0 AHT0 -18 - 13
DM5

Weather Radar System
Figure 011



BM5 34 00 00 0 AHJ0-21

Weather Radar System
Figure 012

**ON A/C 001-004,

(Ref. Fig. 013)

R **ON A/C 005-200,

(Ref. Fig. 014)

**ON A/C ALL

The aircraft is equipped with two digital radio altimeters. The digital outputs are conform to ARINC characteristic 707.
The radio altimeter system is made up of two independent systems, each comprising :
- a transceiver
- two identical antennas, for transmission and reception.
The Height and Decision Height data are displayed on the PFD.
The selection and reading of decision Height are performed on the EFIS Control Panel.
More explanations are given in 34-42.

(3)Automatic Call Out System
The aircraft is equipped with a system of altitude synthesized announcements.
More explanation is given in 34-43.
(Ref. Fig. 015)

R **ON A/C 005-200,

(4)Traffic Collision Avoidance System (TCAS)
The aircraft is equipped with TCAS computer in accordance with ARINC characteristic 735.
The system is made up of the following components :
- a TCAS Computer
- two antennas
- an ATC/TCAS control unit
- two VSI/TCAS indicators.
(Ref. Fig. 016)

**ON A/C ALL

(5)Ground Proximity Warning System
The aircraft is equipped with GPWS in accordance with ARINC characteristic 723.
The system is made up of the following components
- a ground proximity warning computer (GPWC)
- two GPWS/G/S indicator lights
- a GPWS/FAULT indicator light.
More explanations are given in 34-48.

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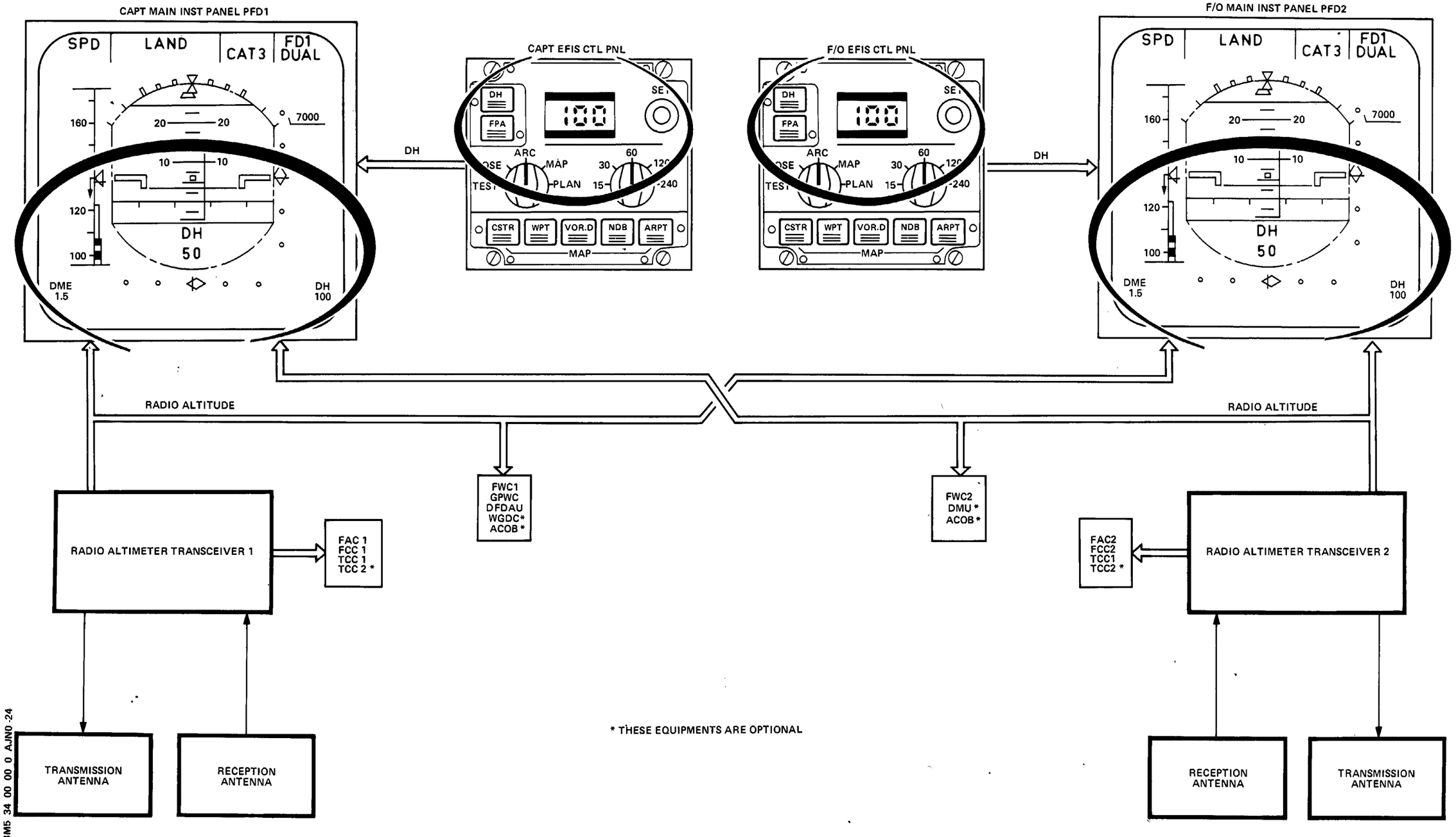
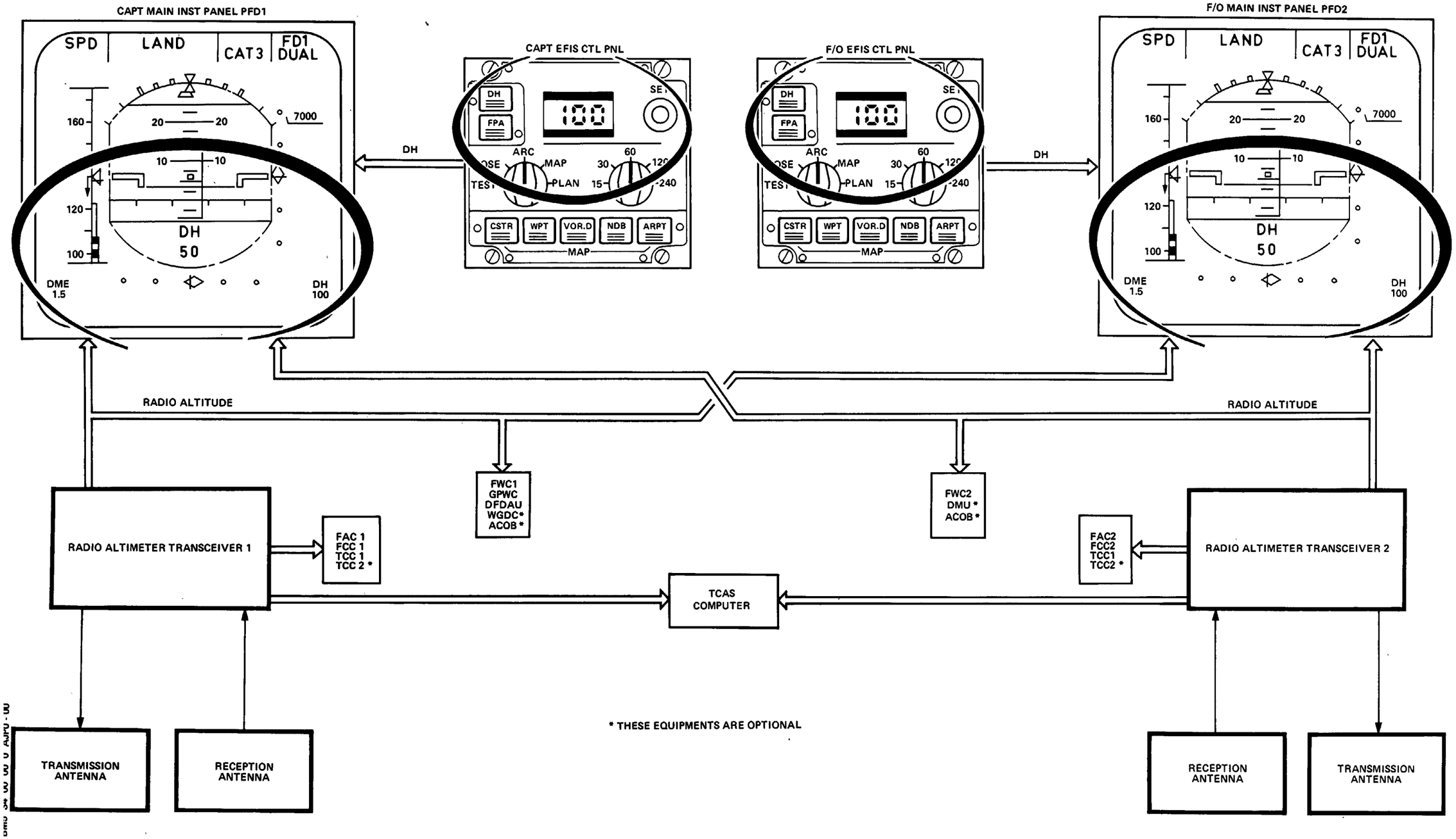
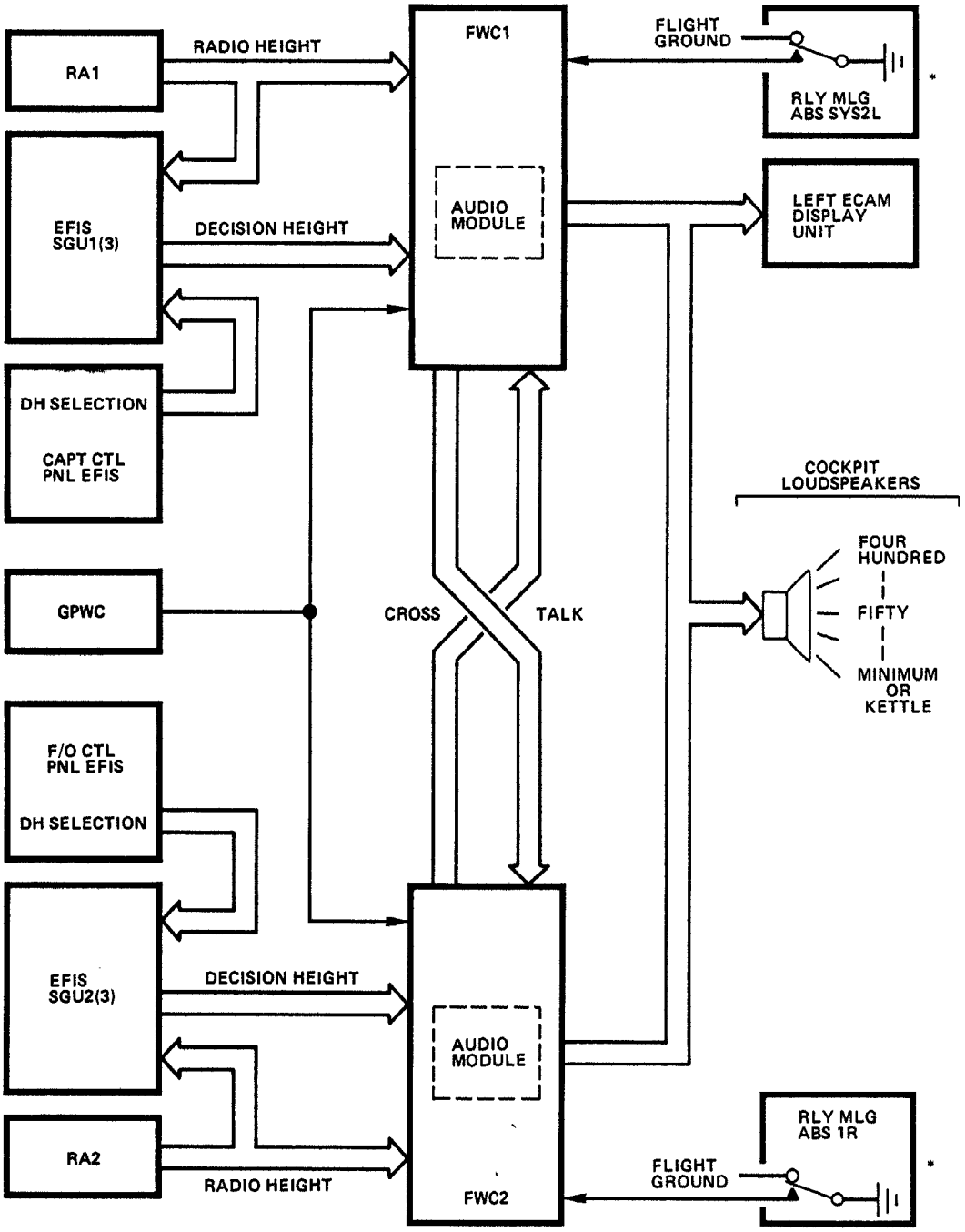


Radio Altimeter
Figure 013



Radio Altimeter
Figure 014



BM5 34 00 00 0 AKC00 24

* THE WIRING FROM GPWC AND MLG RELAYS TO FWC 1 & 2 IS OPTIONAL.

Automatic Call Out System
Figure 015

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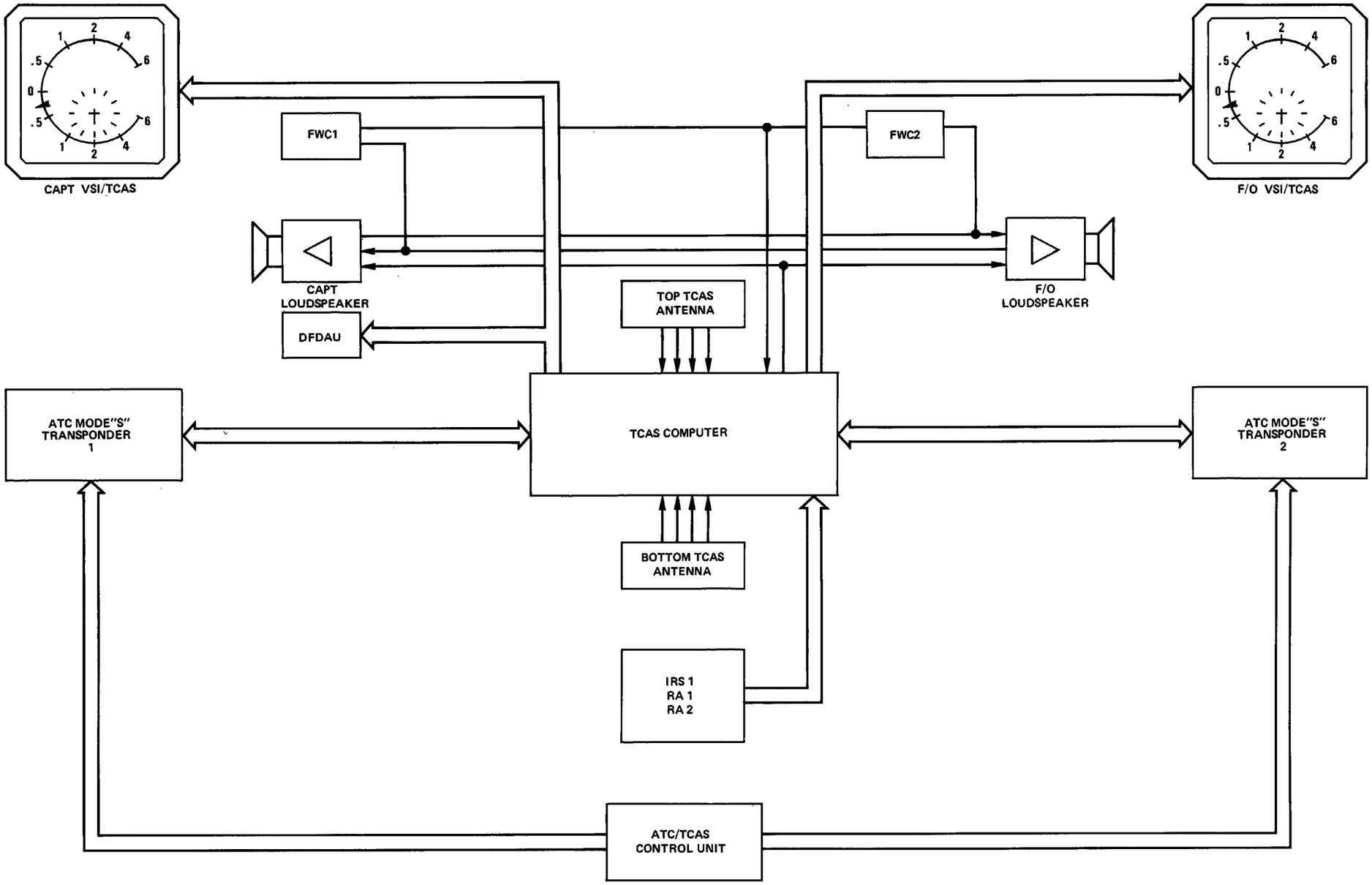


BMD 34 00 00 0 BAMU-00

Traffic Collision Avoidance System
Figure 016

**ON A/C 001-003,

(Ref. Fig. 017)

**ON A/C 004-004,

(Ref. Fig. 018)

R **ON A/C 005-200,

(Ref. Fig. 019)

**ON A/C ALL

E. Radio Navigation Data Dependent Position Determining
This part of the radio-navigation systems comprises :
- DME system (Distance Measuring Equipment)
  This enables the distance separating the aircraft from one or two DME station being received to be known.
- ATC system (AIR TRAFFIC CONTROL)
  This allows an operator of the corresponding equipment on the ground to locate and identify the aircraft on flight without having to communicate with the crew.
- ADF system (Automatic Direction Finder)
  This enables the bearings of one or two ADF ground transmitter stations to be permanently indicated with respect to the aircraft heading.
- VOR system (VHF Omni-Range)
  Firstly this enables the bearings of one or two VOR ground transmitter stations to be permanently indicated with respect to the aircraft heading, and secondly it indicates the aircraft course deviation with respect to a preselected course.

(1)DME

**ON A/C 001-003,

(Ref. Fig. 020)

**ON A/C 004-100,

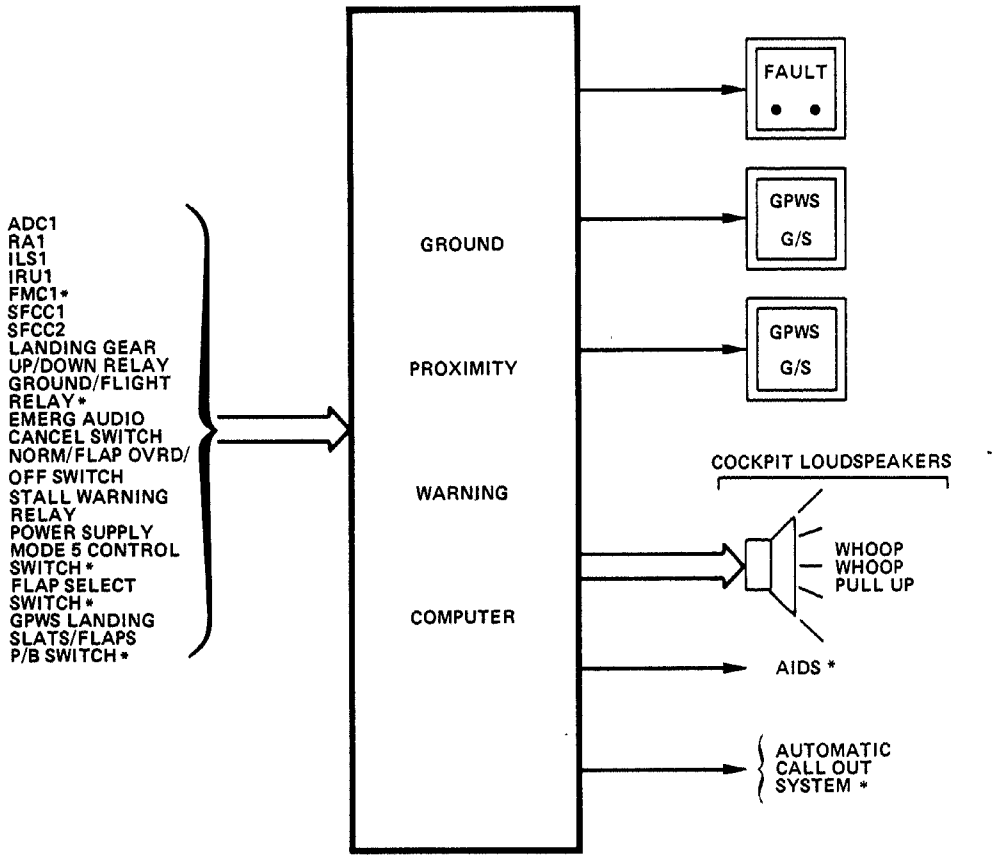
(Ref. Fig. 021)

R **ON A/C 101-200,

R (Ref. Fig. 022)

**ON A/C ALL

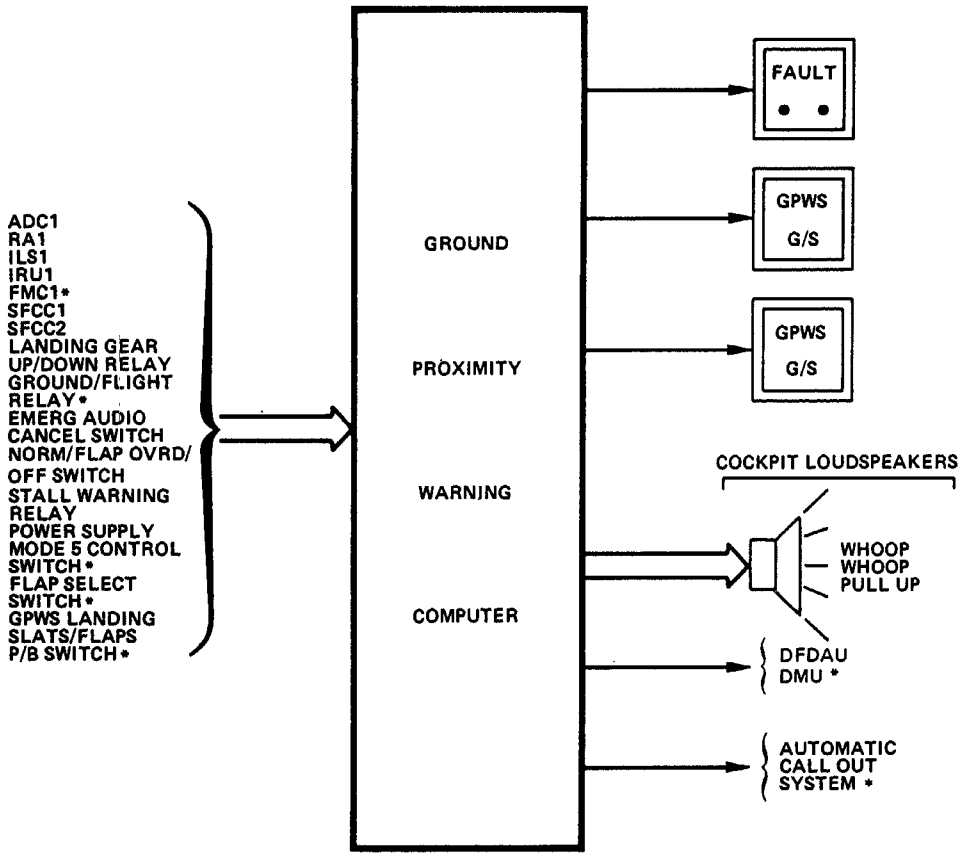
The aircraft is equipped with two DME interrogators designed in compliance with the ARINC characteristic 709. The DME is made up of two



* THE WIRING BETWEEN THESE EQUIPMENTS AND GPWC IS OPTIONAL.

BM5 34 00 00 0 ALG0 00

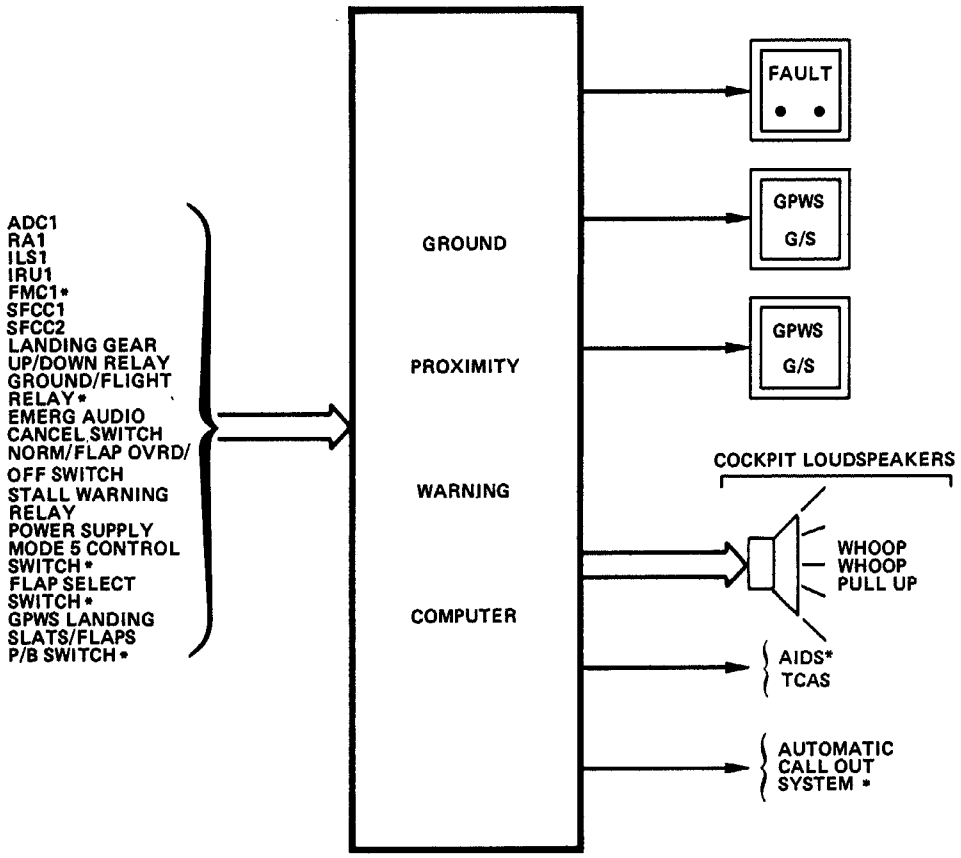
Ground Proximity Warning System
Figure 017



* THE WIRING BETWEEN THESE EQUIPMENTS AND GPWC IS OPTIONAL.

BM5 34 00 00 0 ALR0 00

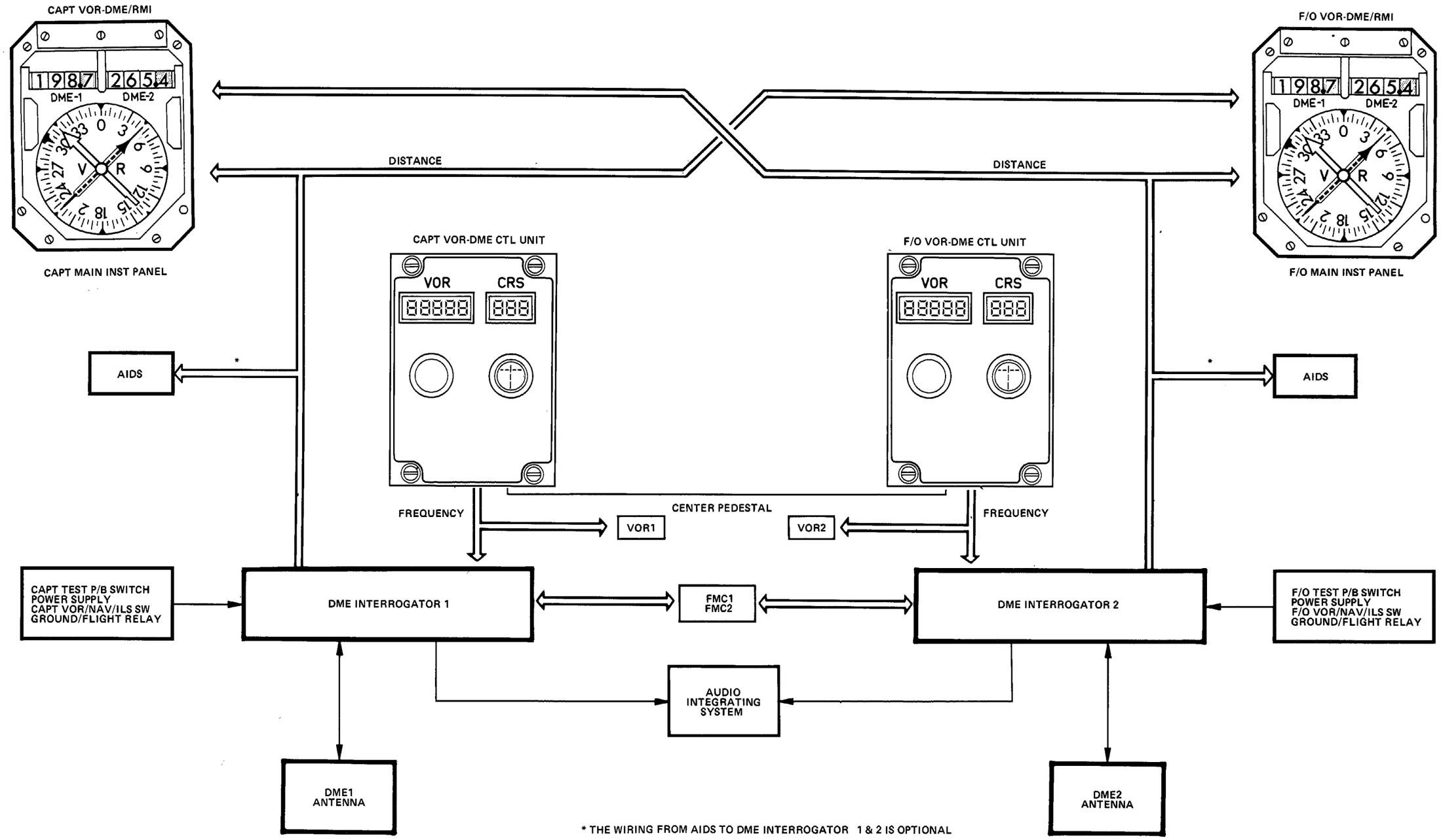
Ground Proximity Warning System
Figure 018



* THE WIRING BETWEEN THESE EQUIPMENTS AND GPWC IS OPTIONAL.

BM5 34 00 00 0 ALSO - 00

Ground Proximity Warning System
Figure 019



BM5 34 00 00 0 AMS0 24

DME
Figure 020

R EFFECTIVITY: 001-003,

PIA

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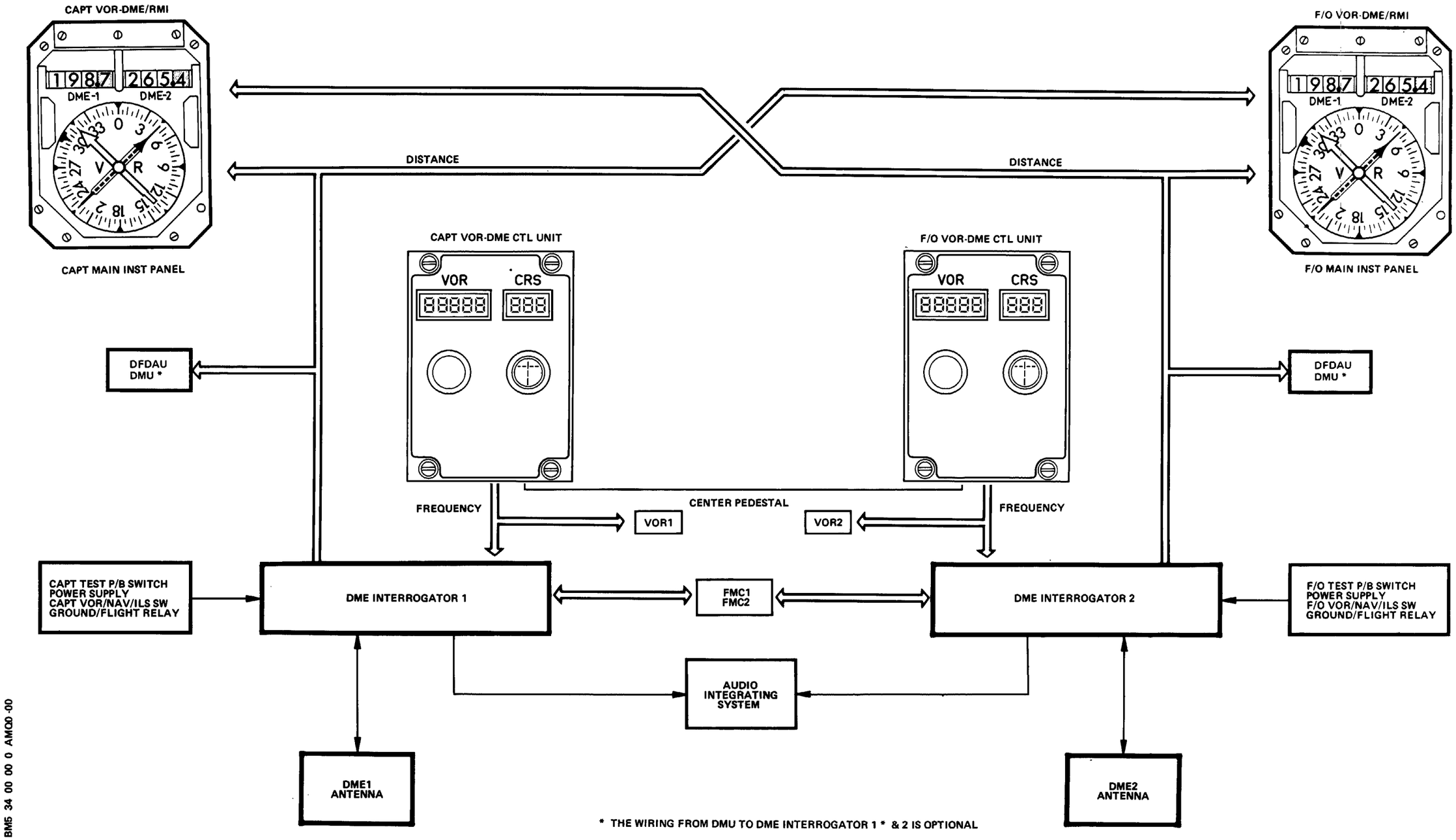
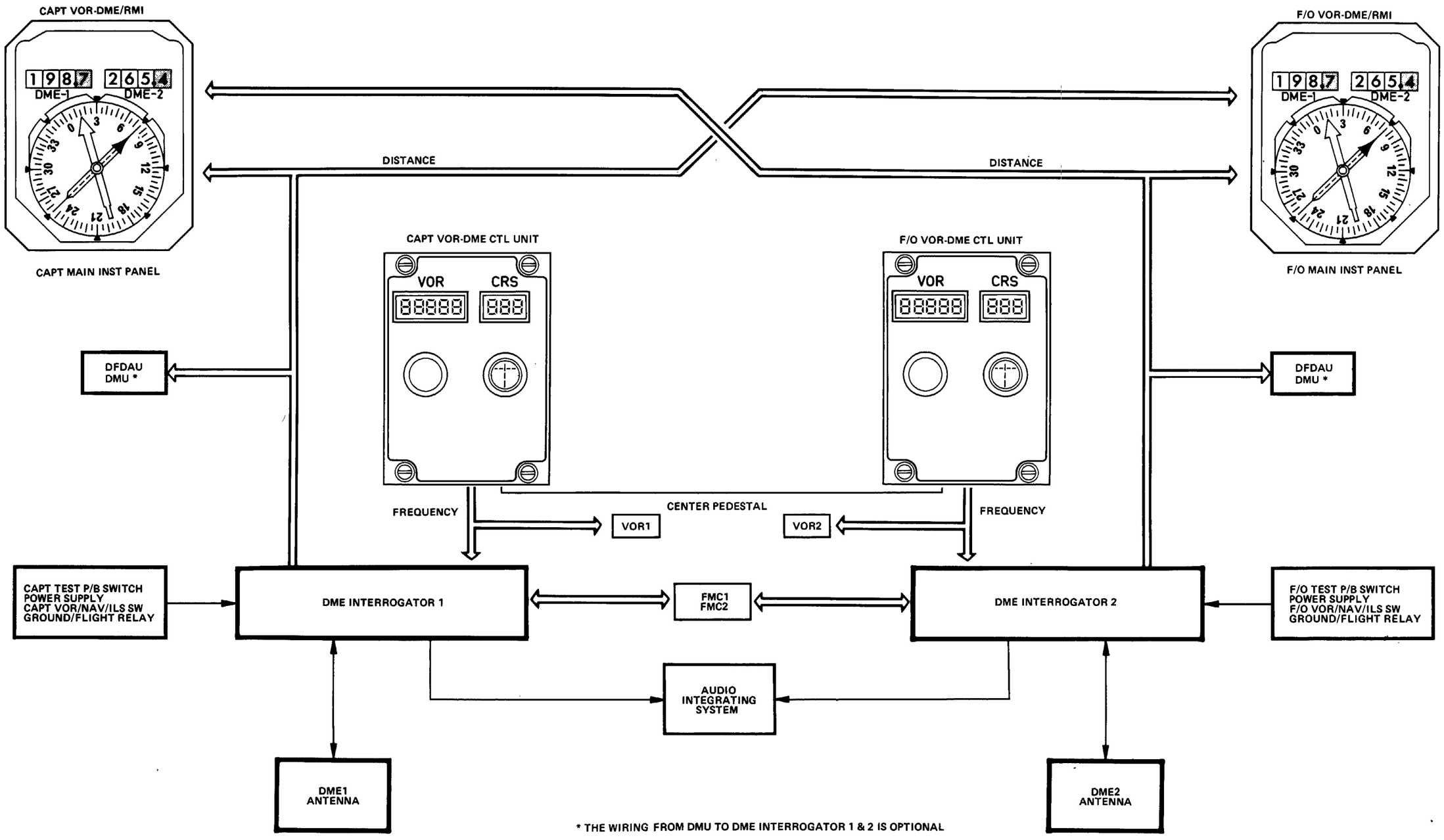


BM5 34 00 00 0 AMC00-00

DME
Figure 021



BM5 34 00 00 0 AMV0 00

R DME
Figure 022

systems comprising respectively :
- one DME interrogator
- one transmission/reception antenna
- one VOR/DME control unit

The distance data are displayed on two VOR/DME RMI.
More explanations are given in 34-51.

(2)ATC

The aircraft is equipped with two ATC transponders in accordance with ARINC characteristic 718.
The system is made up of the following components :
- two ATC transponders which receive altitude data from ADCs
- one ATC/TCAS control unit
- four ATC antennas

More explanations are given in 34-52.

**ON A/C 001-004,

(Ref. Fig. 023)

R **ON A/C 005-200,

(Ref. Fig. 024)

**ON A/C ALL

(3)ADF

The aircraft is equipped with two receivers in accordance with ARINC characteristic 712.
The system is made up of the following components :
- two ADF receivers
- two ADF loop and sense antennas
- two ADF control units

The ADF bearings are displayed on :
- two ADF RMI's
- two EFIS Navigation Display (In Rose Mode).

More explanations are given in 34-53.
(Ref. Fig. 025)

(4)VOR

**ON A/C 001-003,

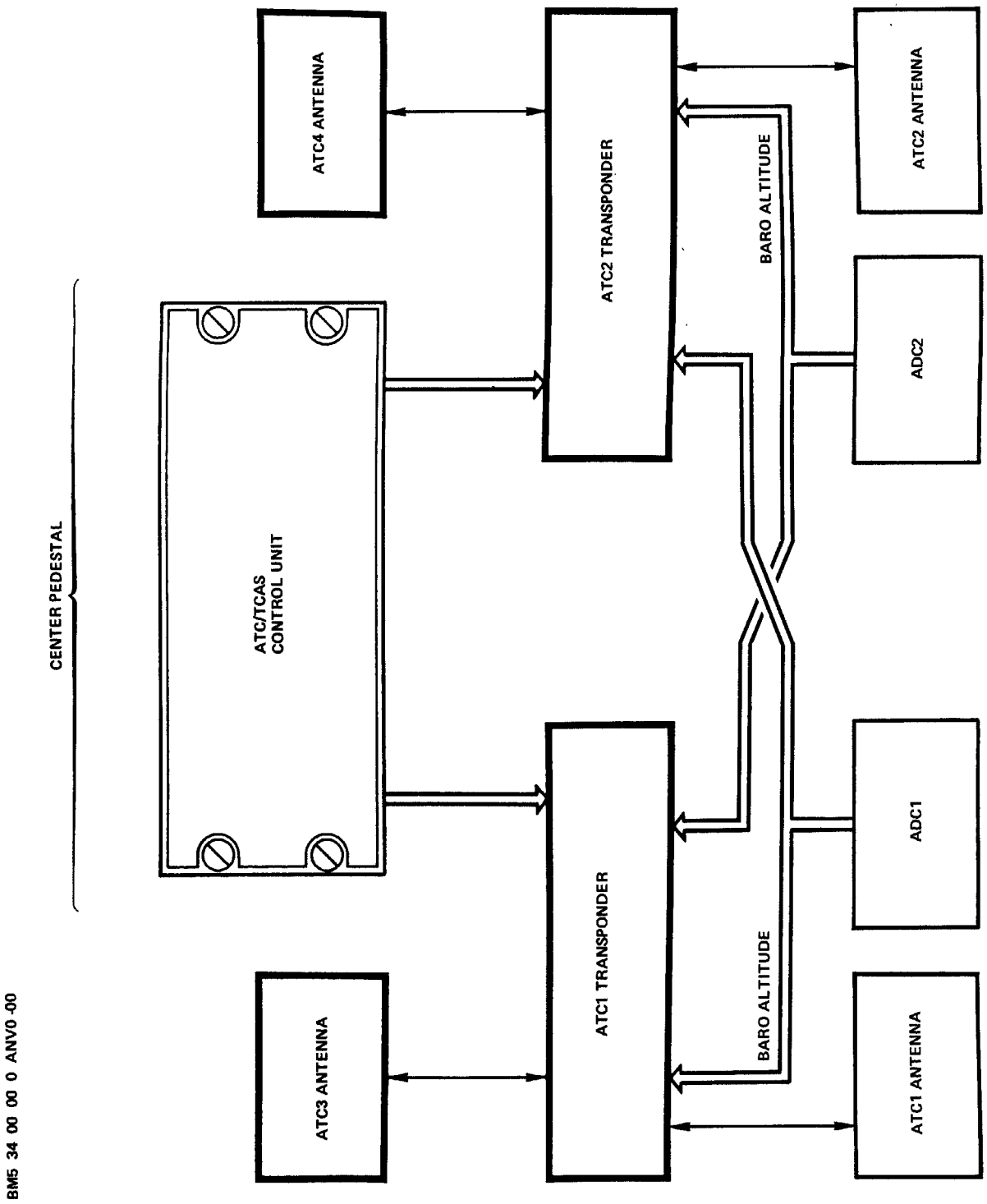
(Ref. Fig. 026)

**ON A/C 004-100,

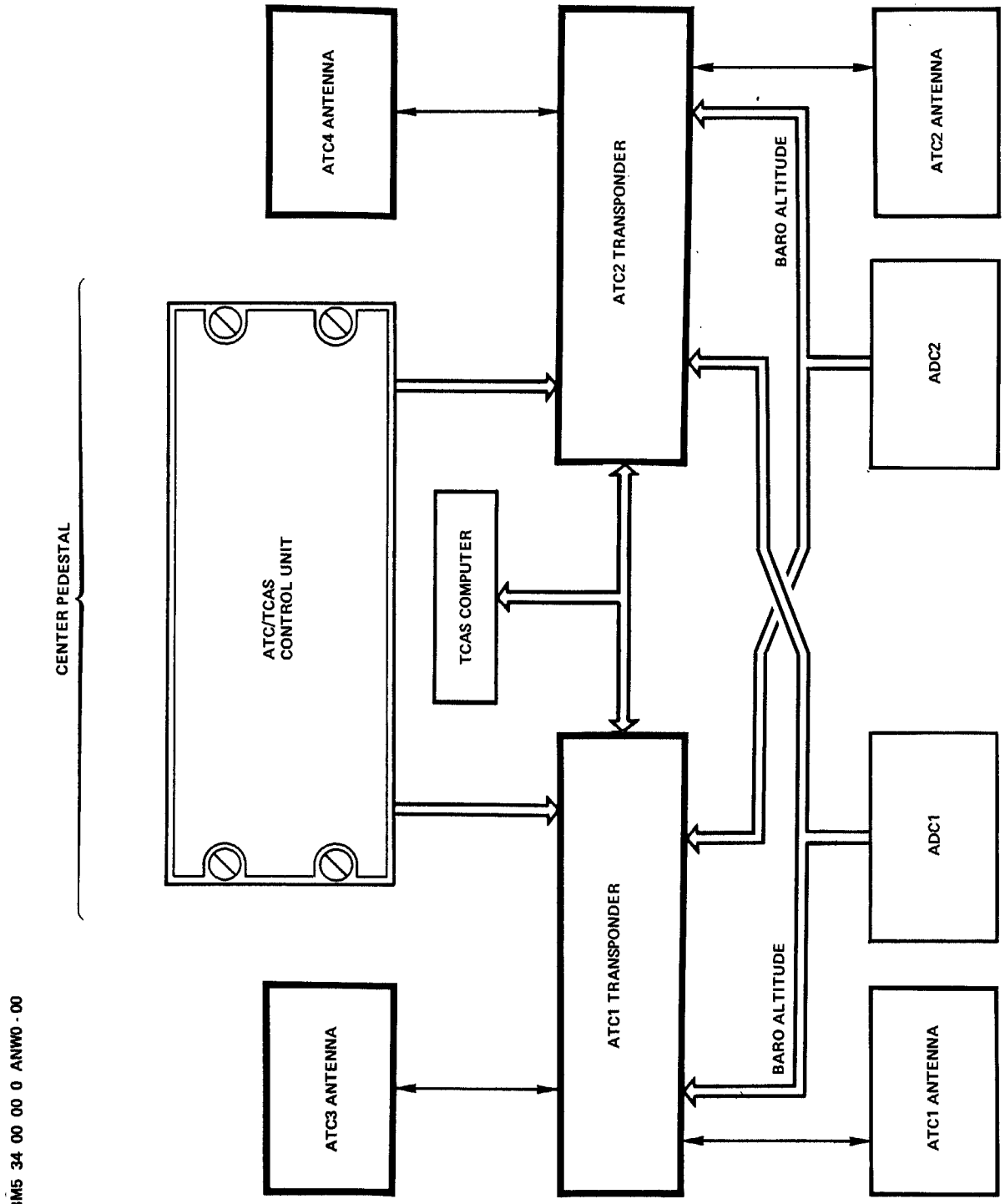
(Ref. Fig. 027)

R **ON A/C 101-200,

R (Ref. Fig. 028)



ATC
Figure 023



ATC
Figure 024

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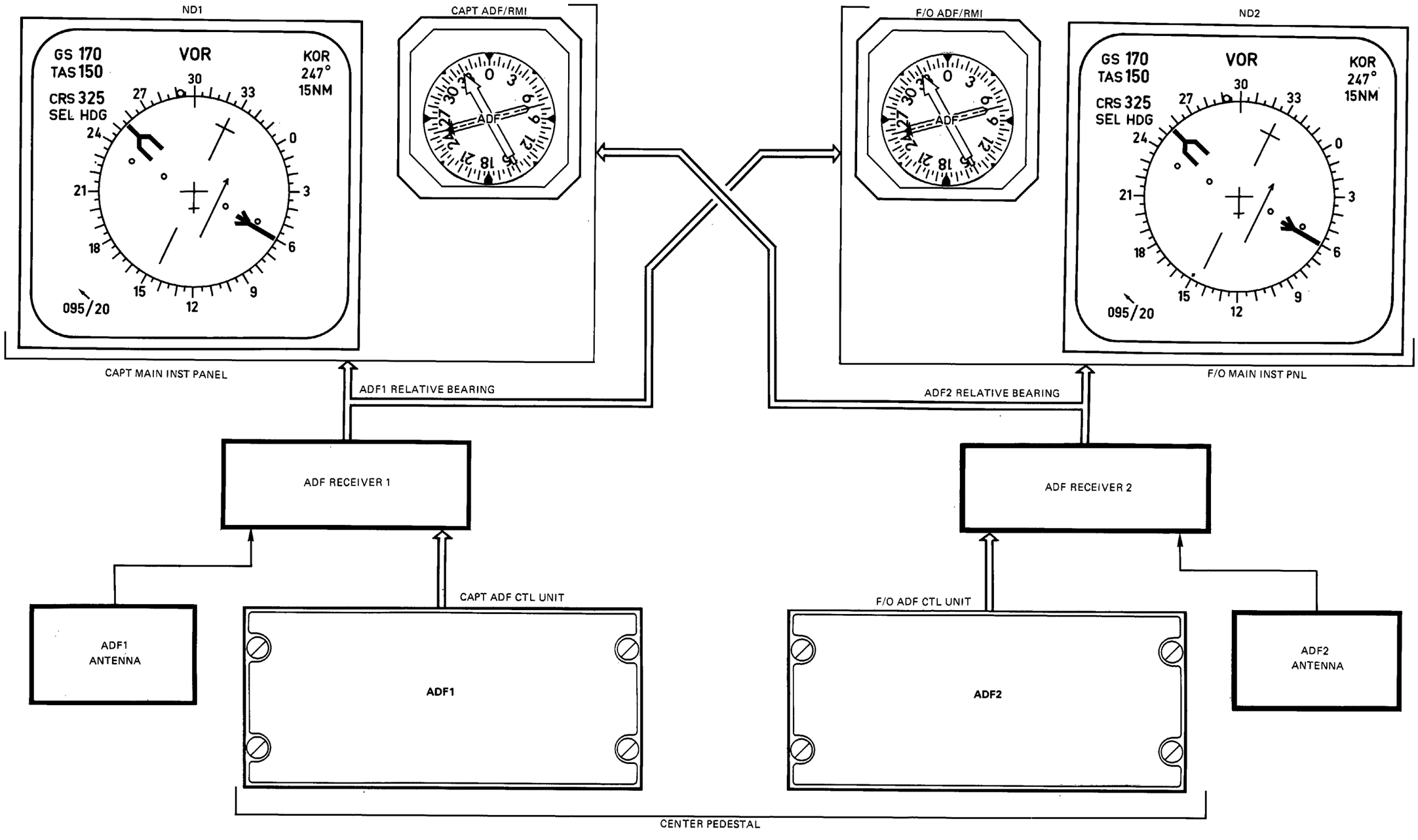

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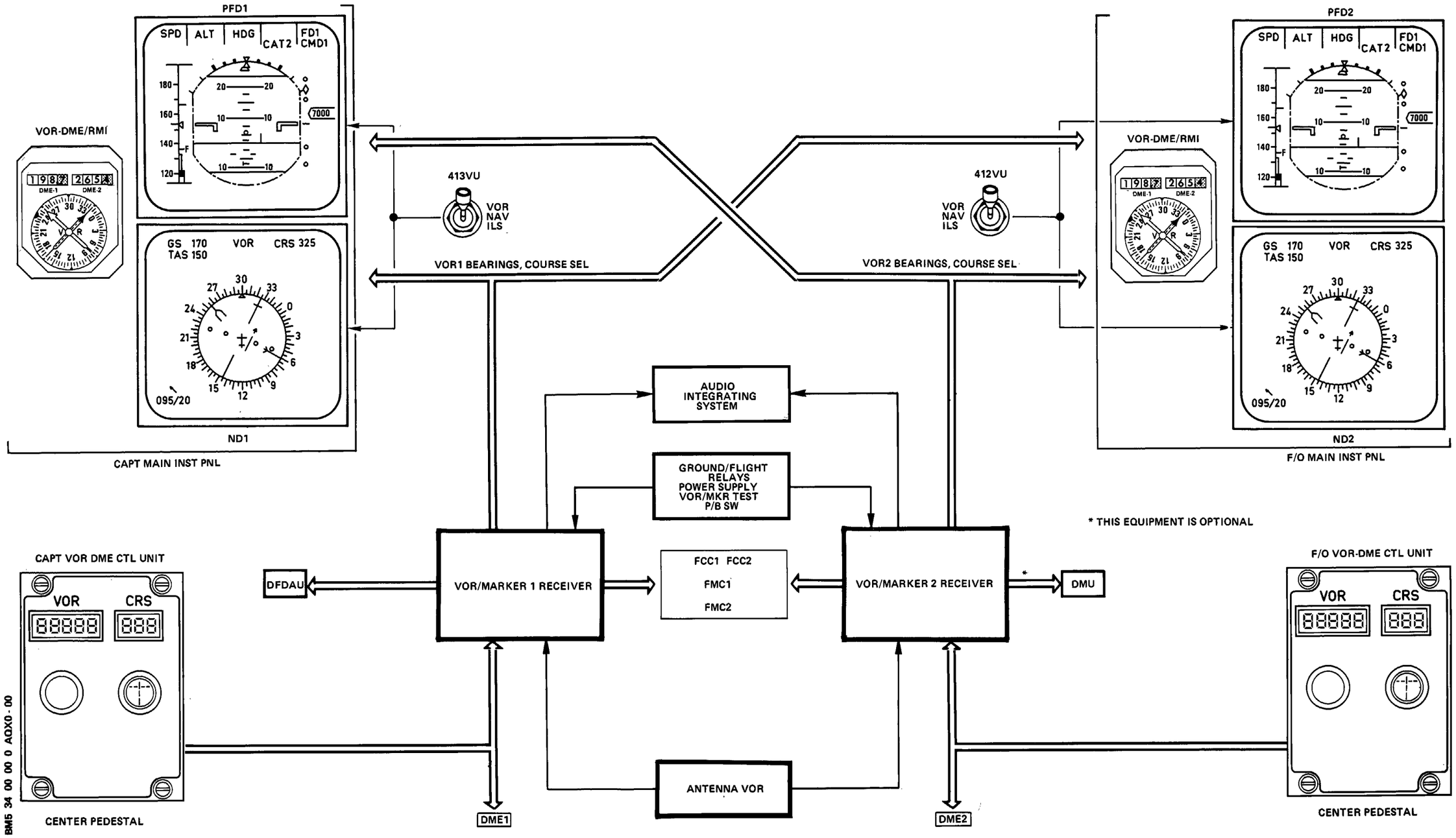
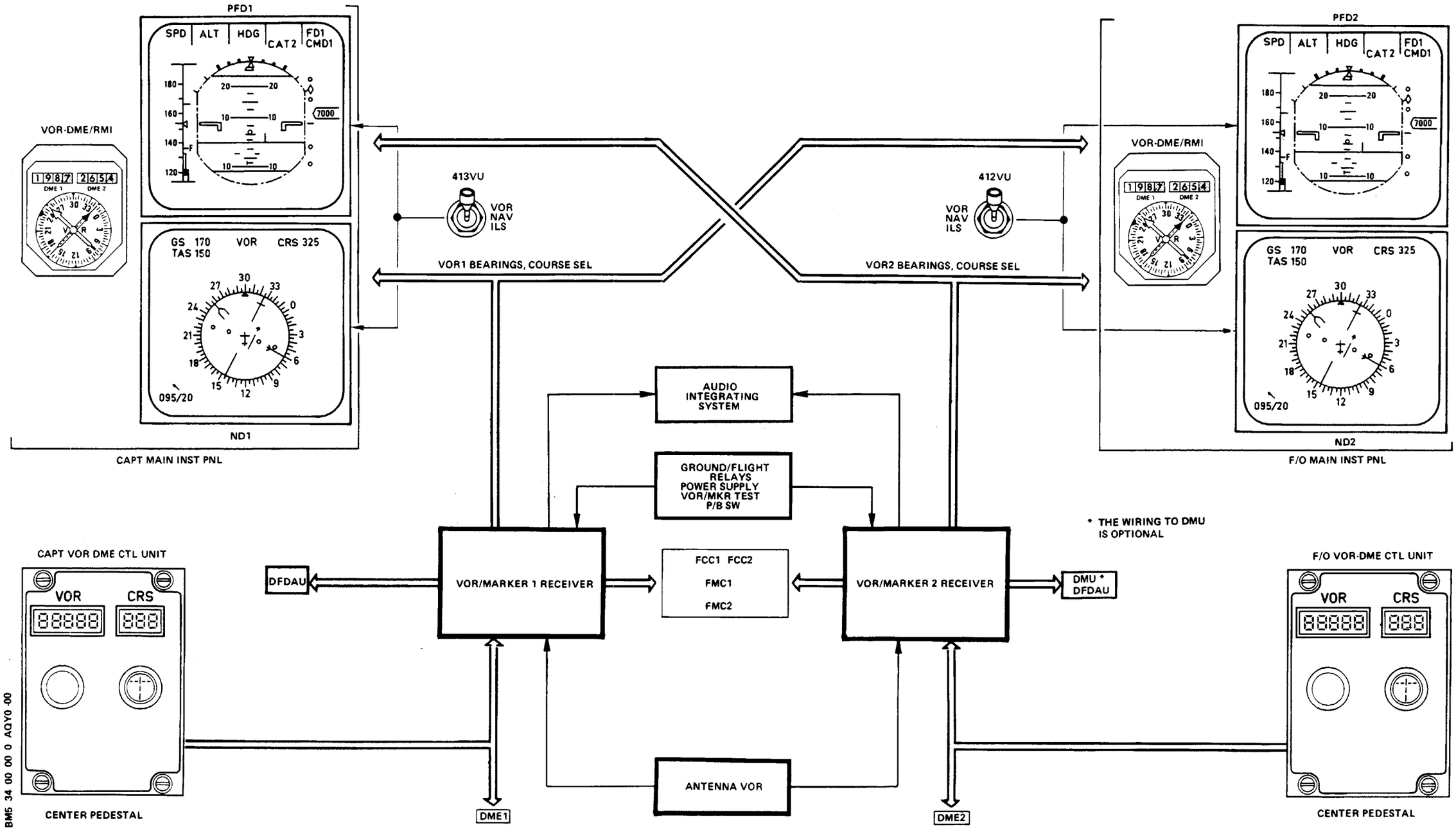
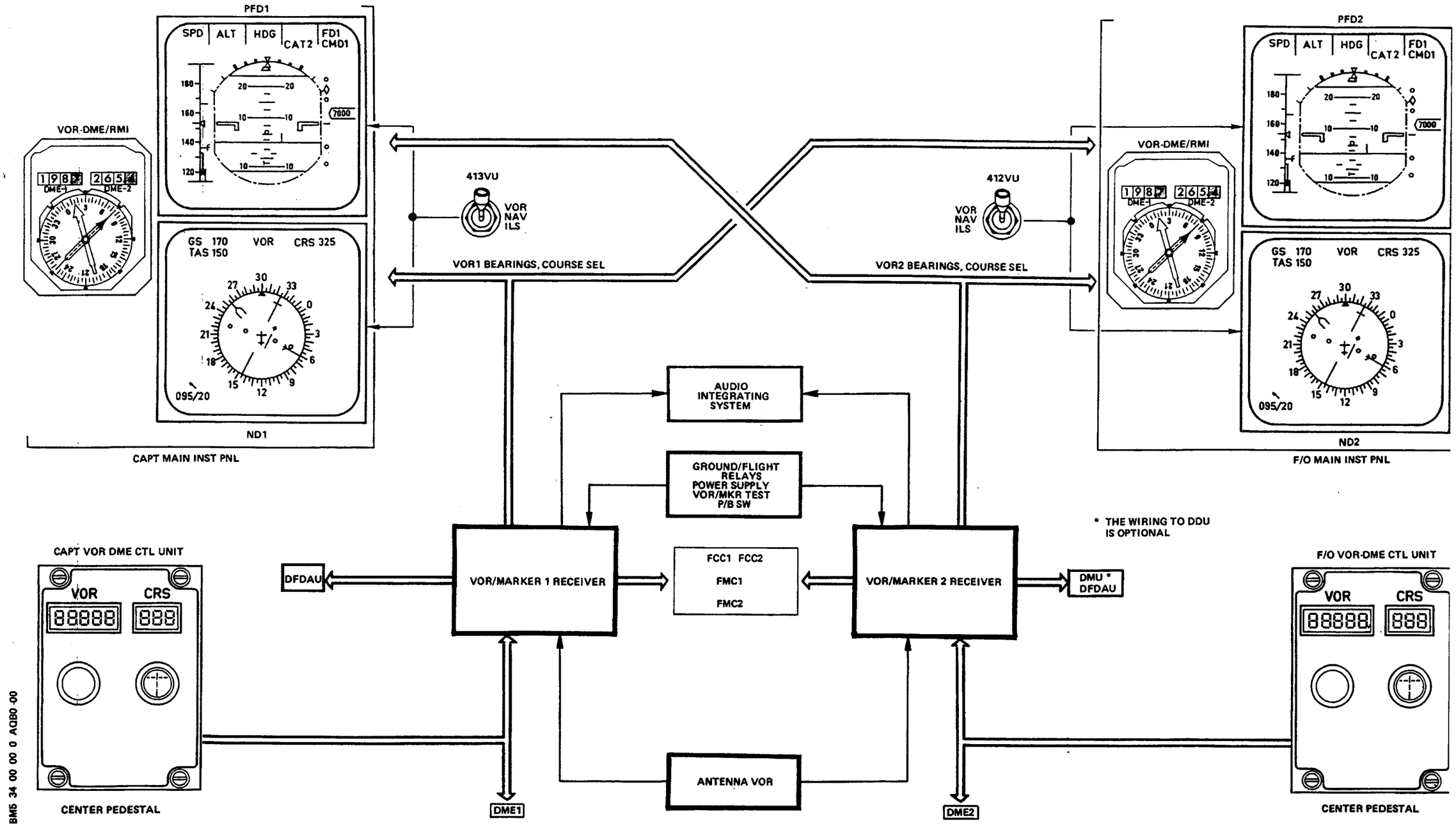
ADF
Figure 025



VOR
Figure 026



VOR
Figure 027



BM5 34 00 00 0 AQB0 00

R VOR
Figure 028

**ON A/C ALL

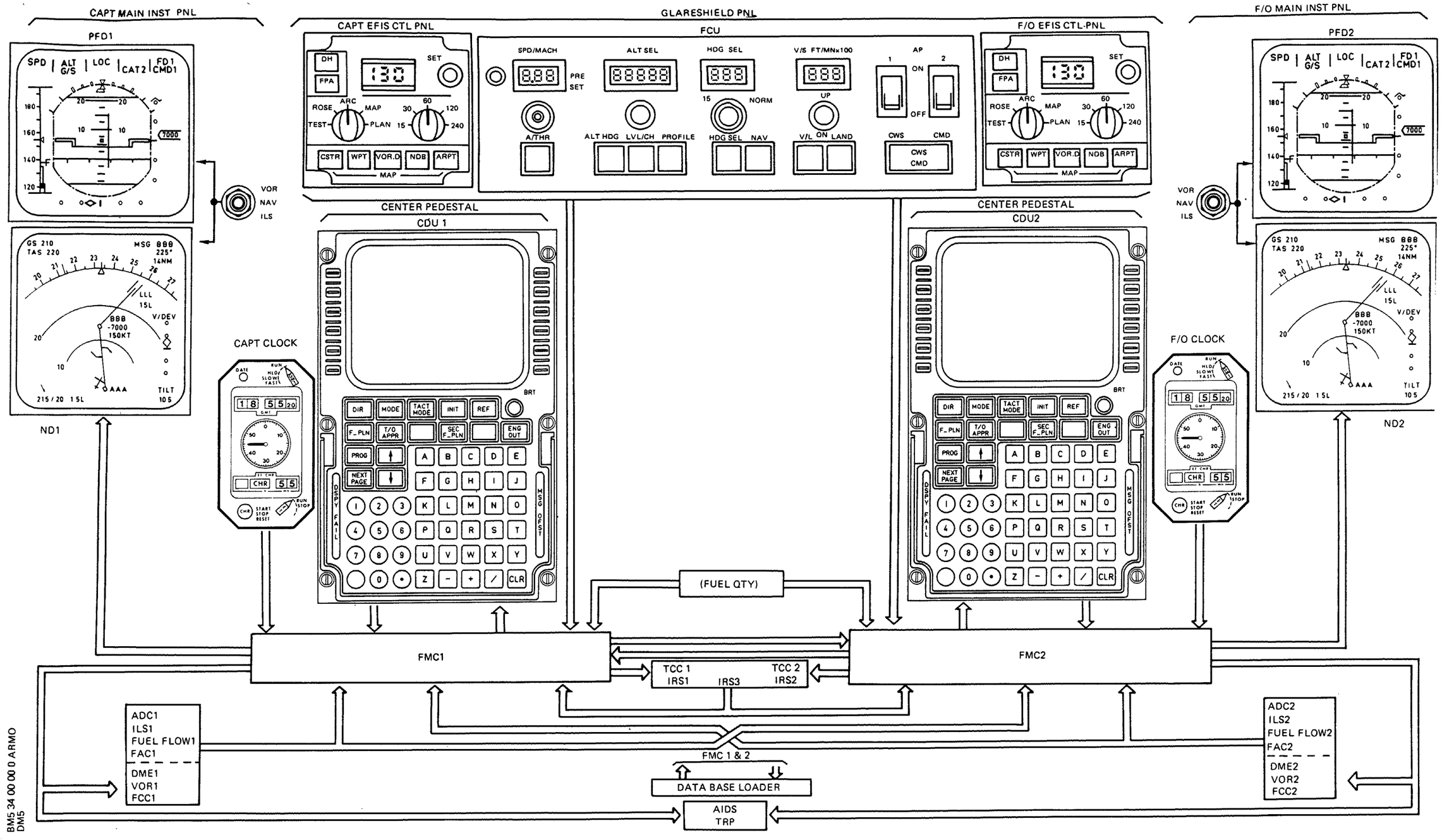
The aircraft is equipped with two VOR/MARKER receivers in accordance with ARINC characteristic 711.
The system is made up of the following components :
- two VOR/MARKER receivers
- two VOR/DME control units
- one VOR antenna

VOR data are displayed on :
- two VOR/DME RMIs
- two EFIS Primary Flight Display
- two EFIS Navigation Display

More explanations are given in 34-55.

F. Flight Management System
(Ref. Fig. 029)
The FMS performs the functions of management, navigation, lateral and vertical guidance and display processing.
The FMS comprises FMCS (FMC + CDU) and peripheral systems.
The aircraft standard configuration is a dual FMC, dual CDU. FMCS architecture with respect to these peripheral systems is generally based on the split cockpit concept.
One FMCS consists of three basic elements, hardware, software and data base. The hardware is FMC and CDU.
The data base is reloadable in the aircraft by means of a tape loader with a portable Data Loader.
Display processing is the formatting and transmission of guidance data and the provision for pilot interaction for planning purposes.
For more details, refer to 34-60.

(1)Position Computing - General (Ref. : 34-60)
(2)FMS - Power Supply (Ref. : 34-61)
(3)FMS - Description/Operation (Ref. 34-63)



BM5 34 00 00 0 ARMO
DM5

FMS
Figure 029

G. Electronic Flight Instrument System (EFIS)

R **ON A/C 001-100,

(Ref. Fig. 030)

R **ON A/C 101-200,

(Ref. Fig. 031)

R **ON A/C ALL

The EFIS displays flight path control and navigation data to the crew. Each pilot has at his disposal two CRT display units on which is displayed all the information that is usually displayed by the following instruments :
- Attitude Director Indicator
- Horizontal Situation Indicator
- Mach Airspeed Indicator
- Radio Altimeter Indicator
- Weather Radar Indicator
- Flight Mode Annunciator

The upper CRT displays the information necessary for short-term aircraft-control, hence the name : Primary Flight Display (PFD), that is : aircraft attitude, computed airspeed (VC) and Mach number, altitude, course deviations etc... The lower CRT, Navigation Display (ND), displays the navigation information necessary for the flight phase : rose, flight plan, radar image, etc...

The EFIS comprises
- four display units (the main elements of which are cathode ray tubes of the high resolution shadow mask type)
- three symbol generator units (SGU) which receive all the data necessary for processing of the images
- two control panels which enable selection of the display mode and display of certain data
- two complementary control panels.

More explanations are given in 34-70 which is divided in compliance with ATA 100 breakdown as follows :

(1)General (Ref. : 34-71)
(2)Data Acquisition (Ref. : 34-72)
(3)Electronic Flight Instrument System (Ref. : 34-73)
(4)Primary Flight Display (PFD)
(5)Navigation Display (ND)

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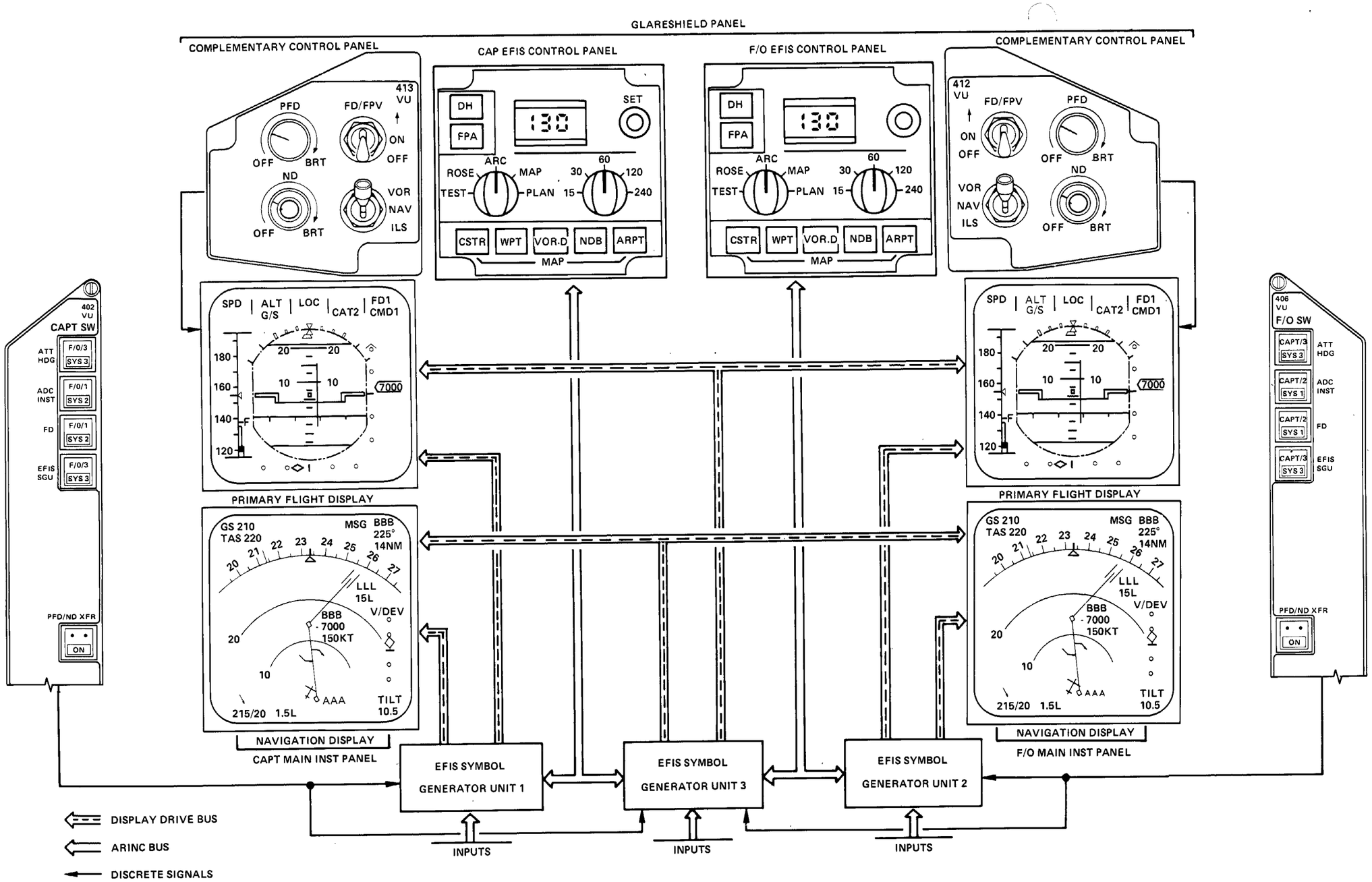

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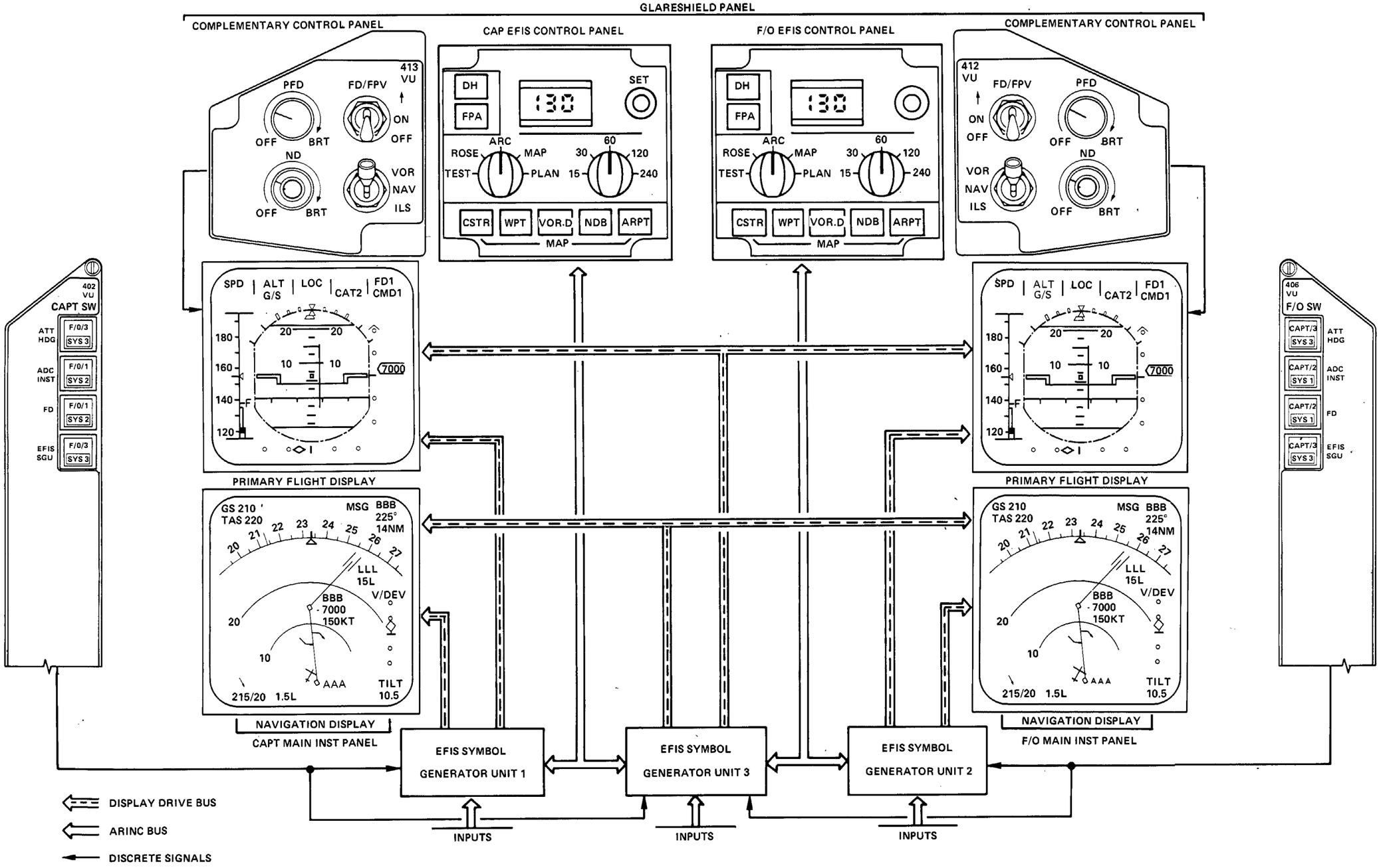
EFIS
Figure 030



BM5 34 00 00 0 ASW0 24 18
DM5

EFIS
Figure 031

1. Inspection/Checks of Navigation Systems

Inspection/checks are divided into two separate groups.

- Brief inspections, which without the necessity of removal, allow a visual check of directly accessible elements.
- Thorough inspections which, after removal or opening of any component obstructing access, allow thorough visual checks of all components of the systems inspected.

A. Brief Inspection

(1) Check the external mechanical condition, attachment and appearance of the following components :
- panels and their equipment,
- connectors,
- rack-mounted system components,
- panel instruments,
- antennas,
- bonding braids.

(2) Check the condition of the wiring (signs of ageing, deterioration, overheating, chafing and kinking which may have an adverse effect on their characteristics).

(3) Change defective components.

B. Thorough Inspection

(1) Open access doors and housings, remove or open panels, shielding and components obtructing inspection (if necessary) in order to gain access to wiring, connectors, electrical interconnections and the various system components.

(a) For the various components.
- remove dust by means of a vacuum-cleaner and clean if necessary,
- check labels and their identification markings,
- check attachment and appearance of these components.

(b) For wiring
- check condition of identification sleeves or labels, coatings, fittings and protective devices,
- check wiring condition (signs of ageing, deterioration, overheating, chafing and kinking which may have an adverse effect on their characteristics).

(c) For connectors and electrical interwiring.
- disconnect connectors, check their mechanical and electrical condition, look for rusting and corrosion and replace defective parts (seals, gaskets, grommets, bindings, etc.),
- check that interconnections between all electrical units, bonding and grounding braids, bus and terminal bars are tight.
- check locking of non wirelocked connectors.

(2) Change defective components.

(3) Return aircraft installation to operating condition.

FLIGHT ENVIRONMENT DATA - DESCRIPTION AND OPERATION

1. General

The flight environment data is provided by :
- static probes
- pitot probes
- total air temperature probes
- alpha probes

This information is used for computation of the following :
- altitude
- airspeed
- VMO
- Mach number
- true airspeed
- static air temperature
- total air temperature

2. Component Location

(Ref. Fig. 001)
(Ref. Fig. 002)
(Ref. Fig. 003)

**ON A/C 001-003,

(Ref. Fig. 004)

R **ON A/C 004-200,

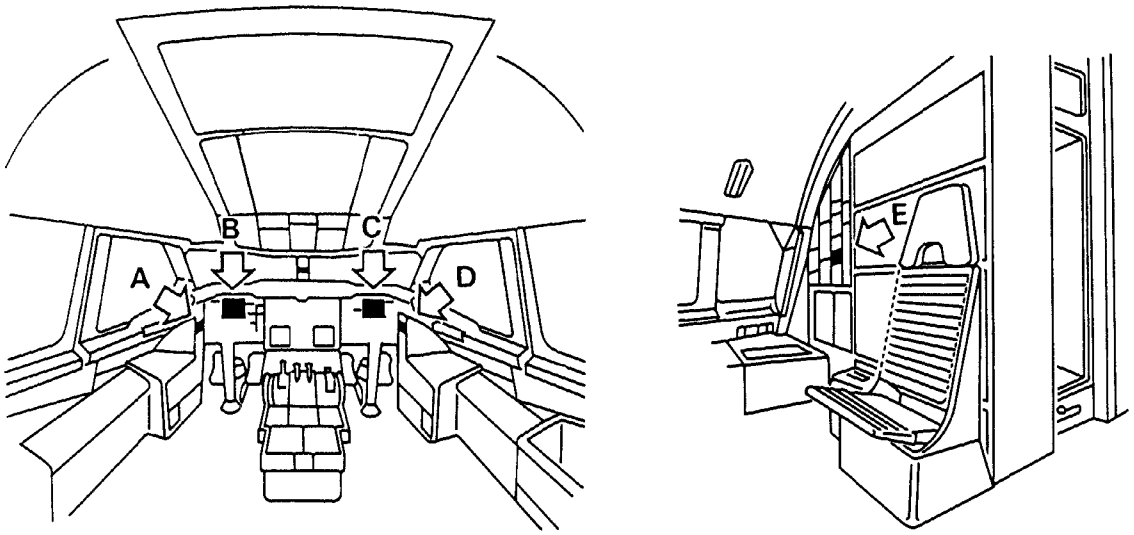
(Ref. Fig. 005)

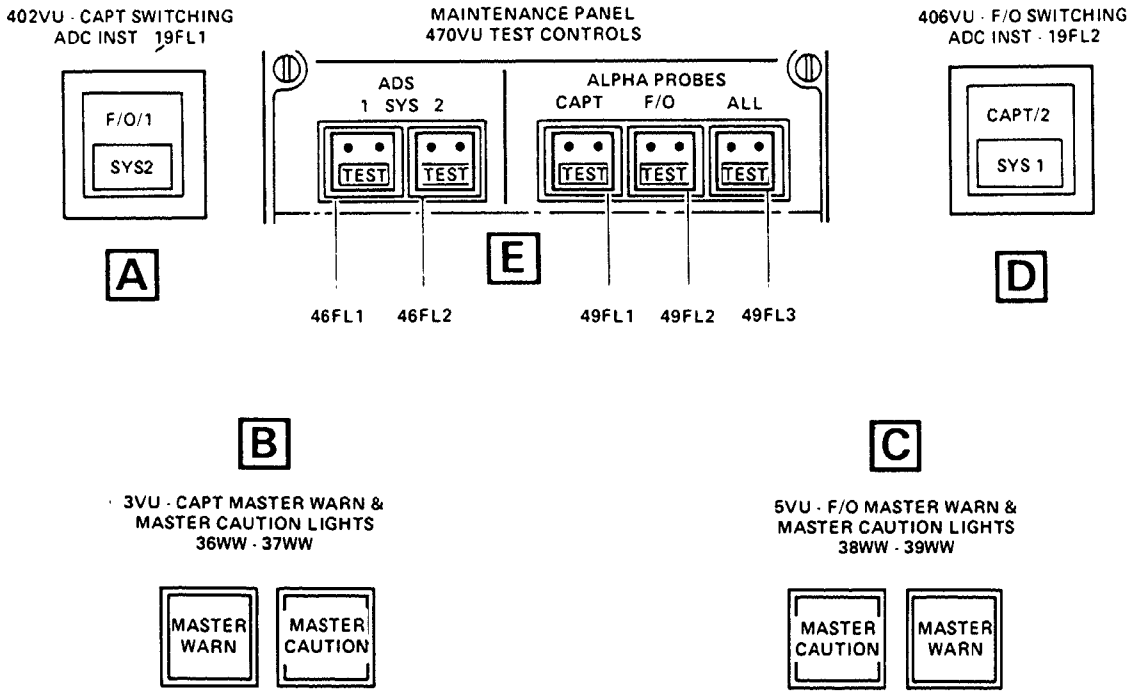
**ON A/C ALL

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
1FL1	ADC-1	96VU	122	121BL	34-11-34
1FL2	ADC-2	86VU	121	121BL	34-11-34
2FL1	ALTIMETER-MAIN, CAPT	3VU	211		34-12-21
2FL2	ALTIMETER-MAIN, F/O	5VU	212		34-12-21
**ON A/C 001-003,					
5FL1	IND-VERTICAL SPEED, CAPT	3VU	211		34-14-21
5FL2	IND-VERTICAL SPEED, F/O	5VU	212		34-14-21
R **ON A/C 004-200,					
15FL1	IND-VSI/TCAS, CAPT	3VU	211		34-14-21
15FL2	IND-VSI/TCAS, F/O	5VU	212		34-14-21

R **ON A/C ALL

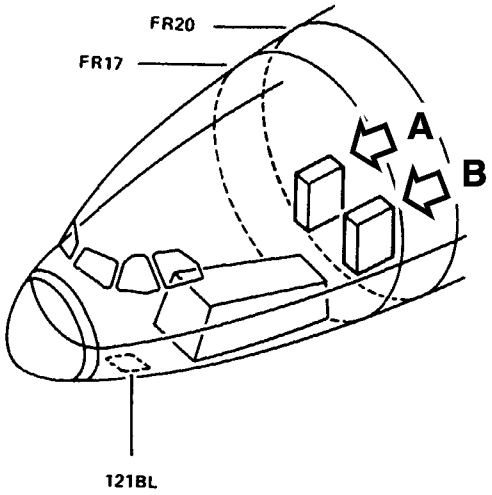
19FL1	P/BSW-ADC INST, CAPT	402VU	211	
19FL2	P/BSW-ADC INST, F/O	406VU	212	
46FL1	P/BSW-ADS/SYS1	470VU	212	
46FL2	P/BSW-ADS/SYS2	470VU	212	
49FL1	P/BSW-ALPHA PROBES/CAPT	470VU	212	
49FL2	P/BSW-ALPHA PROBES/F/O	470VU	212	
49FL3	P/BSW-ALPHA PROBES/ALL	470VU	212	
52FL	ALTIMETER-METRIC	3VU	211	34-12-25
59FL	ALTIMETER-STBY	4VU	210	34-12-22
60FL1	IND-STBY AIRSPEED, CAPT	3VU	211	34-13-22
60FL2	IND-STBY AIRSPEED, F/O	5VU	212	34-13-22
62FL1	TEST PLUG - ADC1 FWC1 ECAM	90VU	122	
62FL2	TEST PLUG - ADC2 FWC2 ECAM	80VU	121	
63FL	SWITCH-L/G DOWN VMO/MMO SELECTION	90VU	122	
34FN1	PFD-CAPT	3VU	211	34-74-22
34FN2	PFD-F/O	5VU	212	34-74-22
36FN1	ND-CAPT	3VU	211	34-75-22
36FN2	ND-F/O	5VU	212	34-75-22
1WT1	DISPLAY UNIT-ECAM, LEFT	4VU	210	31-57-22
3WT1	DISPLAY UNIT-ECAM, RIGHT	4VU	210	31-57-23
36WW	LIGHT-MASTER WARN, CAPT	3VU	211	
37WW	LIGHT-MASTER CAUTION, CAPT	3VU	211	
38WW	LIGHT-MASTER WARN, F/O	5VU	212	
39WW	LIGHT-MASTER CAUTION, F/O	5VU	212	

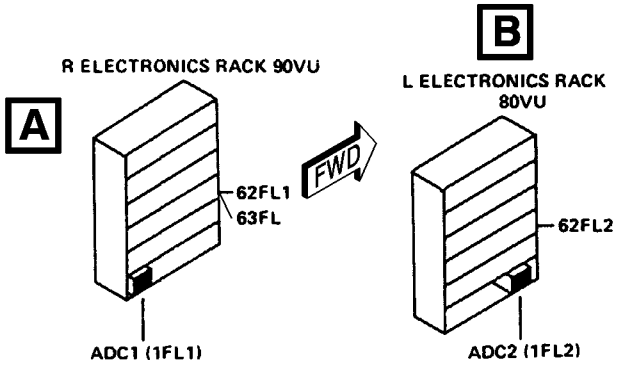


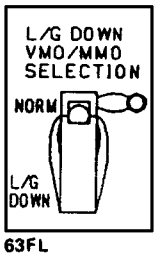


BM5 34 10 00 0 SRLO 13 08
DM5

Flight Environment Data - Component Location - Sheet 1/4
Figure 001



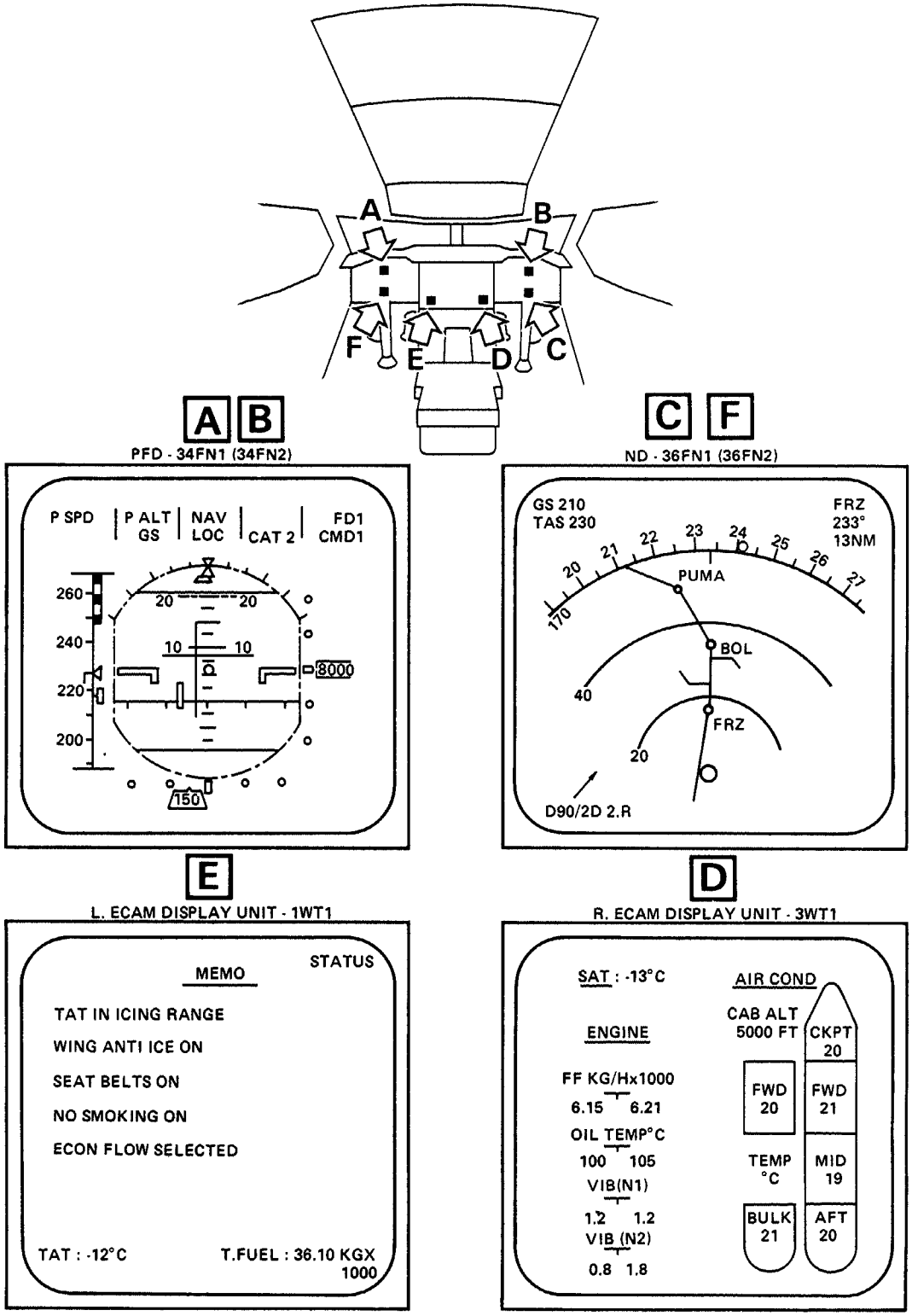




BM5 34 10 00 0 SRK0 02

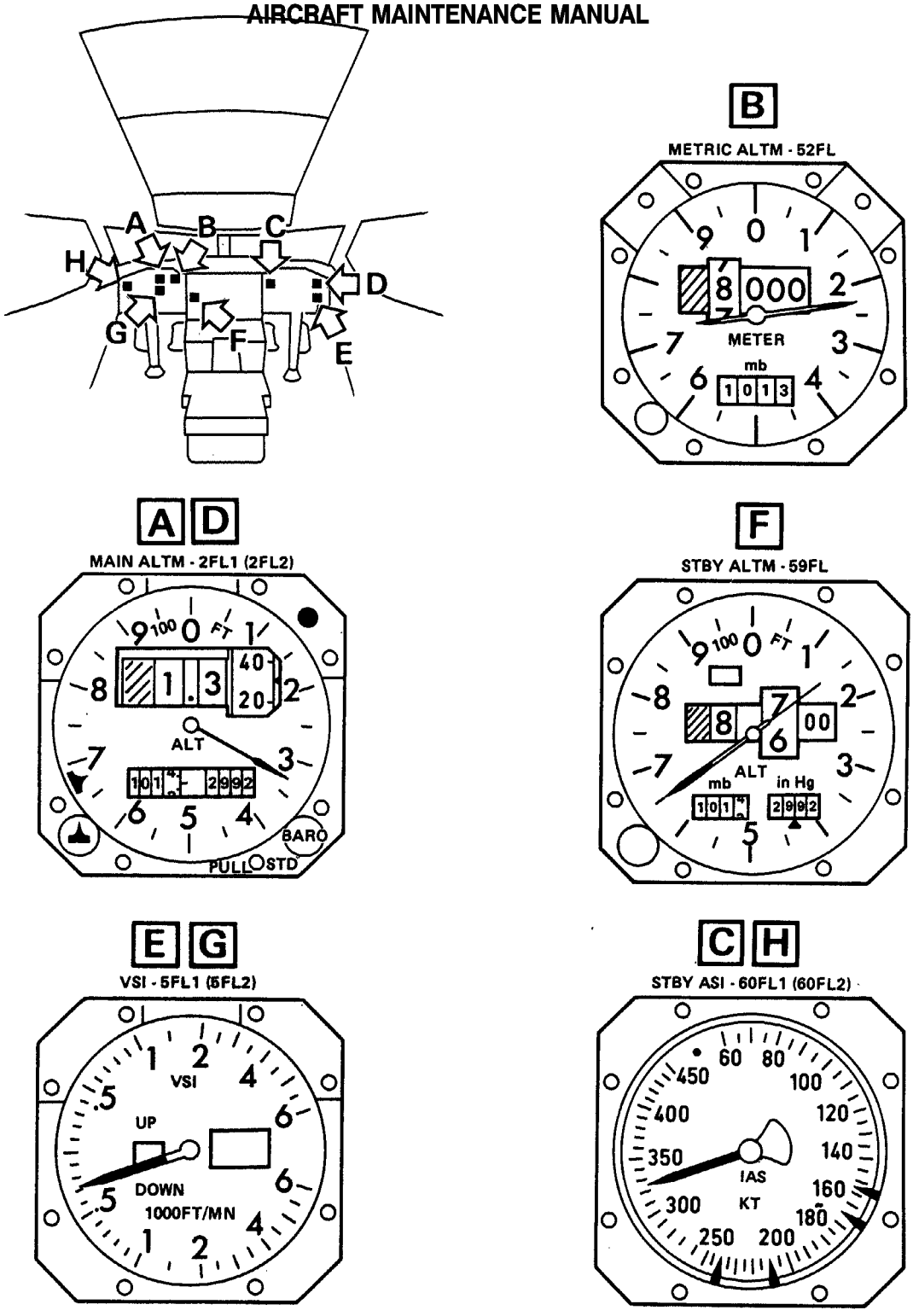
Flight Environment Data - Component Location - Sheet 2/4
Figure 002

R



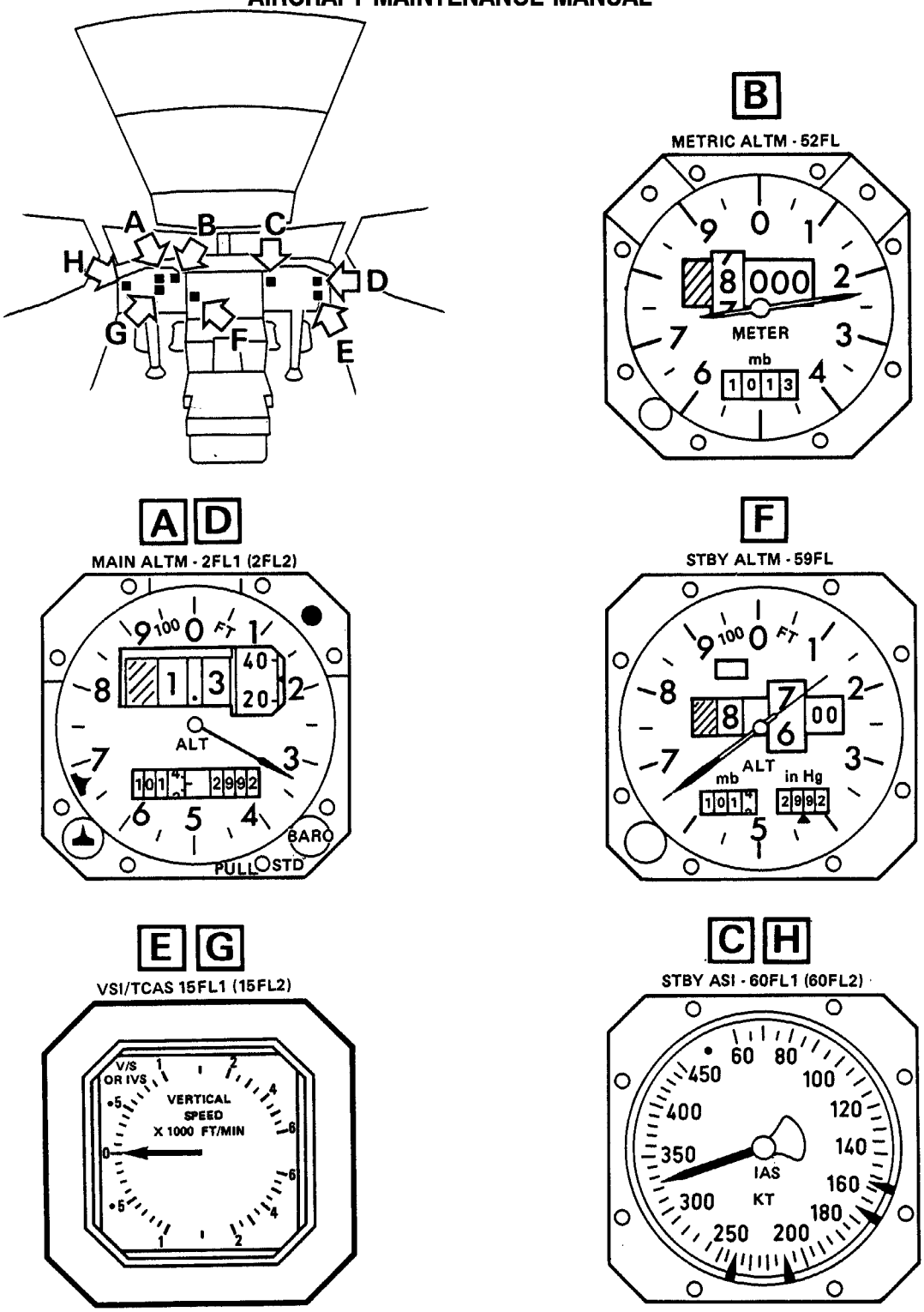
BM5 34 10 00 0 BBK0 · 01

Flight Environment Data - Component Location - Sheet 3/4
Figure 003



BM5 34 10 00 0 SRN0 - 01

Flight Environment Data - Component Location - Sheet 4/4
Figure 004



BM5 34 10 00 0 SRC0 - 00

Flight Environment Data - Component Location - Sheet 4/4
Figure 005

3. Description

**ON A/C 004-100,

(Ref. Fig. 006)

**ON A/C 001-003,

(Ref. Fig. 007)

**ON A/C 101-200,

R (Ref. Fig. 008)

**ON A/C ALL

The flight environment data is provided by three independent systems :
- two main systems (LH and RH)
- one standby system

A. Main (or Normal) Systems
Each of these two systems includes two static probes, one pitot (total pressure) probe, one total air temperature (TAT) probe and one ALPHA probe which provide an ARINC 706 air data computer (ADC) with the data necessary for the generation of parameters which are transmitted to the indicators and to the various aircraft systems.

**ON A/C 001-003,

Under normal conditions, ADC1 provides outputs for :
- instruments on Captain's instrument panel : altimeter, vertical speed indicator and Primary Flight Display (through associated EFIS SGU1 or 3)

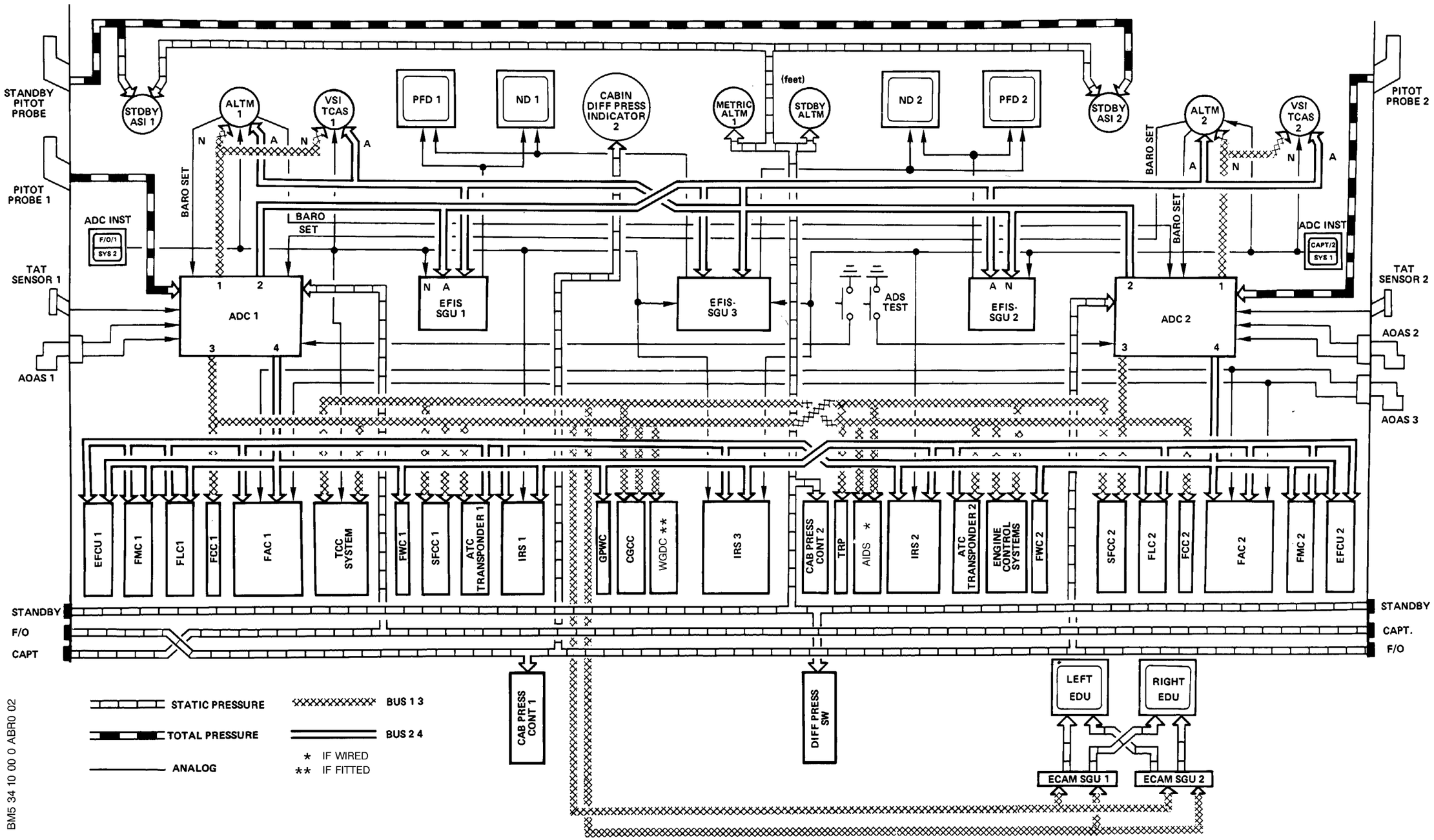
**ON A/C 004-200,

Under normal conditions, ADC1 provides outputs for :
- instruments on Captain's instrument panel : altimeter, VSI/TCAS indicator and Primary Flight Display (through associated EFIS SGU1 or 3).

**ON A/C 001-003,

- systems that make use of ADS information : FAC1 and 2, FCC1, TCC1 and TCC2 (if fitted), IRS1, 2 and 3, EFCU1 and 2, Engines control systems, FMC1 and 2, FLC1 and 2, FWC1, SFCC1 and 2, ATC transponders 1 and 2, DFDAU or DMU (if fitted), GPWC, WGDC (if fitted) ECAM SGUs 1, 2 and 3 and CGCC (if fitted).

Under normal conditions ADC2 provides outputs for :
- instruments on First Officer's instrument panel : altimeter, vertical speed indicator, Primary Flight Display (through associated EFIS SGU2 or 3).



BM5 34 10 00 0 ABR0 02

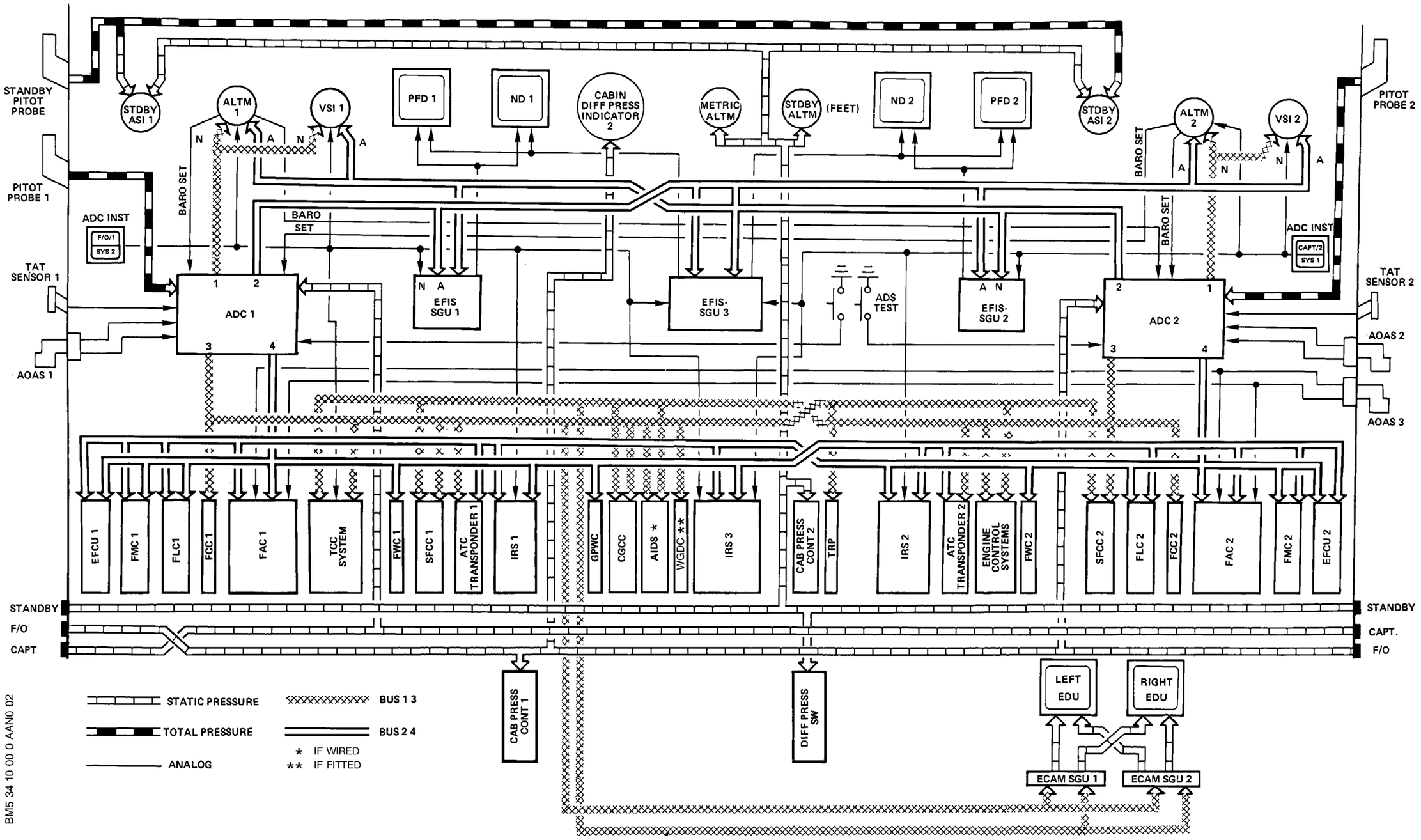
Air Data System - Block Diagram
Figure 006

R

R EFFECTIVITY: 004-100,

PIA

Printed in France



BM5 34 10 00 0 AAN0 02

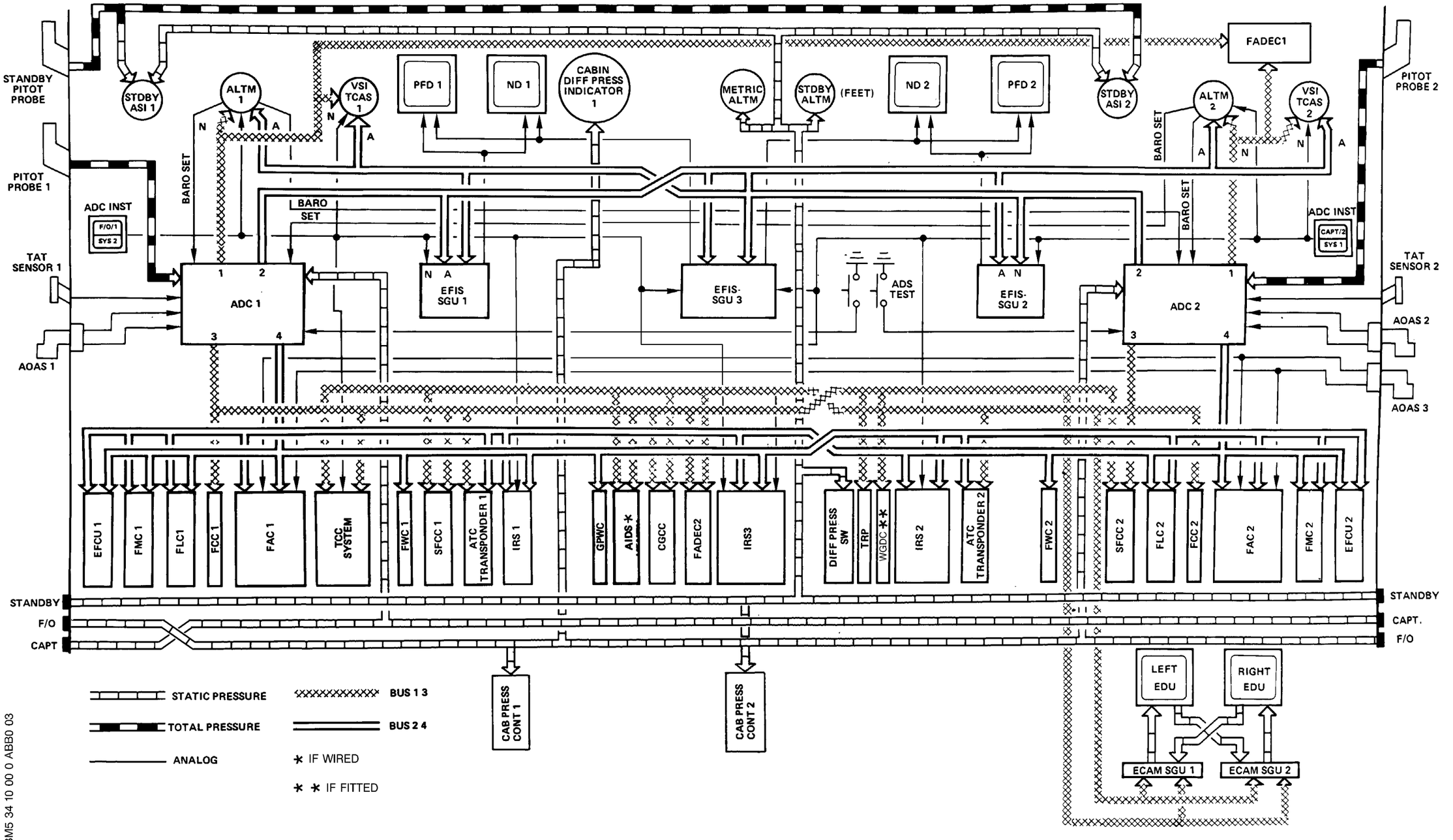
Air Data System - Block Diagram
Figure 007

R

R EFFECTIVITY: 001-003,

PIA

Printed in France



BM5 34 10 00 0 ABB0 03

Air Data System - Block Diagram
Figure 008

R

- systems that make use of ADS information : FAC1 and 2, FCC2, TCC1 and TCC2 (if fitted), IRS1, 2 and 3, EFCU1 and 2, Engine control systems, FMC1 and 2, FLC1 and 2, FWC2 SFCC1 and 2, ATC transponders 1 and 2, ECAM SGUs 1, 2 and 3, DMU (if fitted) and CGCC (if fitted).

**ON A/C 004-100,

- systems that make use of ADS information : FAC1 and 2, FCC1, TCC1 and TCC2 (if fitted), IRS1, 2 and 3, EFCU1 and 2, Engines control systems, FMC1 and 2, FLC1 and 2, FWC1, SFCC1 and 2, ATC transponders 1 and 2, DFDAU or DMU (if fitted), GPWC, WGDC (if fitted) ECAM SGUs 1, 2 and 3 and CGCC (if fitted).

Under normal conditions ADC2 provides outputs for :
- instruments on First Officer's instrument panel : altimeter, VSI/TCAS indicator, Primary Flight Display (through associated EFIS SGU2 or 3).
- systems that make use of ADS information : FAC1 and 2, FCC2, TCC1 and TCC2 (if fitted), IRS1, 2 and 3, EFCU1 and 2, Engine control systems, FMC1 and 2, FLC1 and 2, FWC2 SFCC1 and 2, ATC transponders 1 and 2, ECAM SGUs 1, 2 and 3, DMU (if fitted) and CGCC (if fitted).

**ON A/C 101-200,

- systems that make use of ADS information : FAC1 and 2, FCC1, TCC1 and TCC2 (if fitted), IRS1, 2 and 3, EFCU1 and 2, FADEC 1 and 2, FMC1 and 2, FLC1 and 2, FWC1, SFCC1 and 2, ATC transponders 1 and 2 DFDAU or DMU (if one of them is fitted), GPWC, WGDC (if fitted) ECAM SGUs 1 and 2 and CGCC (if fitted).

Under normal conditions ADC2 provides outputs for :
- instruments on First Officer's instrument panel : altimeter, VSI/TCAS indicator, Primary Flight Display (through associated EFIS SGU2 or 3).
- systems that make use of ADS information : FAC1 and 2, FCC2, TCC1 and TCC2 (if fitted), IRS1, 2 and 3, EFCU1 and 2, FADEC 1 and 2, FMC1 and 2, FLC1 and 2, FWC2 SFCC1 and 2, ATC transponders 1 and 2, ECAM SGUs 1, 2, DMU (if fitted) and CGCC (if fitted).

**ON A/C ALL

In the event of failure of one of the ADCs, all the instruments and the IRSs in the failed system can be manually switched over to the other ADC.
A built-in test equipment enables an operational test of the instruments and systems to be performed on the ground by simulation of specific flight conditions.

B. Standby System
The standby system includes two static probes and one pitot probe which directly supply the standby airspeed indicators on Captain's and First Officer's main instrument panels, the standby altimeter (in feet) on upper center instrument panel and the metric altimeter on Captain's main instrument panel.

C. Angle-of-Attack Data
This data is provided by three ALPHA probes, two of which are located on the RH side and one on the LH side of the aircraft centerline.
ALPHA probes 1 and 2 supply the ADCs.
ALPHA probe 3 directly supplies FAC1 and FAC2.
These probes can be tested through the maintenance panel.

4. Controls and Indicating

A. Main Instruments
(1)Altimeters
They provide altitude in feet through a drum display and a pointer performing one revolution for 1000 ft.

**ON A/C 001-003,

(2)Vertical Speed Indicators
They provide baro-inertial vertical speed (computed by the IRS) or barometric vertical speed computed by the ADCs in feet per minute.

R **ON A/C 004-200,

(2)Vertical Speed/TCAS Indicators
They provide baro-inertial vertical speed (computed by the IRS) or barometric vertical speed computed by the ADCs in feet per minute. They can also display Traffic Advisory (TA) and Resolution Advisory (RA) (computed by TCAS computer).

**ON A/C ALL

(3)Primary Flight Displays (CRT-EFIS)
These display
. computed airspeed (Vc) in knots
. VMO in knots
. Mach number
. an analog indication of the difference between present altitude and selected altitude.
(4)Navigation Displays (CRT-EFIS)
These display true airspeed in knots in the digital format, in the upper LH side.

B. Standby Instruments
(1)Altimeter (in feet)
It provides altitude in feet through a drum display and a pointer performing one revolution for 1000 ft.
(2)Metric altimeter
It provides altitude in meters through a drum display and a pointer performing one revolution for 1000 meters.
(3)Airspeed Indicators
They provide airspeed in knots.

C. Captain's Controls
On LH instrument panel 402VU, ADC INST pushbutton switch enables switchover to ADC2 in case of ADC1 failure :
. the upper section comes on and displays F/O/1 legend when the First Officer instruments are switched over to ADC1 by the First Officer.
. the lower section comes on and displays SYS2 legend when the pushbutton switch is pressed by the Captain.

The Captain instruments then repeat ADC2 information.

D. First Officer's Controls
On RH Instrument panel 406VU, ADC INST pushbutton switch enables switchover to ADC1 in case of ADC2 failure :
. the upper section comes on and displays CAPT/2 legend when the Captain instruments are switched over to ADC2 by the Captain
. the lower section comes on and displays SYS1 legend when the pushbutton switch is pressed by the First Officer.
The First Officer instruments then repeat ADC1 information.

E. Warnings

(1)The warnings concerning the ADCs and associated instruments are displayed as follows :

- local warnings on instruments that make use of ADC information
- MASTER WARN and MASTER CAUTION lights on CAPT and F/O main instrument panels 3VU and 5VU for ADC failure or failures of system that make use of ADC information.
- an aural warning : single chime
- a visual warning message displayed on left ECAM display unit.

A detailed description of these warnings is given in paragraph 5. Utilization.

(2)Repetitive chime overspeed aural warning is triggered

. when VMO/MMO range is exceeded (detected by the ADCs); in that case, the warning is triggered by the FWCs.

A detailed description of these warnings is provided in paragraph 5. Utilization

F. Test Controls

These are located on maintenance panel 47OVU.

They include :

- two ADS SYS1 and SYS2 test pushbutton switches enabling the functional test of both ADCs.
- three ALPHA PROBES test pushbutton switches : CAPT, F/O and ALL enabling respectively the tests of Captain probe, First Officer probe and all three probes simultaneously.

G. Landing/Gear Down VMO/MMO Selection Switch

"L/G Down VMO/MMO SELECTION" switch can be activated from Electronics Compartment during an exploitation flight with landing gear down and locked in these conditions :

- Maximum speed with landing gear down :
  255 kt TAS or M = 0.65
- Take off prohibited in icing weather conditions.
- Extended flying over sea prohibited.

5. Utilization

A. Normal Conditions
- The instruments are normally supplied :
  . Captain's instruments are connected to ADC1
  . First Officer's instruments are connected to ADC2
  . Captain's and First Officer's ADC INST pushbutton switches are off.
- Test pushbutton switches on maintenance panel are off.
- Both ADCs are operational as soon as the aircraft electrical circuits are energized.

B. Failure of ADC and Associated Instruments

Any failure detected triggers :
- a local warning on the instruments that make use of ADC information.
- MASTER WARN and MASTER CAUTION lights on CAPT and F/O main instrument panels 3VU and 5VU for ADC failure or failures of systems that make use of ADC information.
- an aural warning : single chime
- a visual warning message on L ECAM display unit.

The various messages displayed indicate :
. the failure origin
. the actions to be taken
. the failure consequences.

This data will be processed by the crew in accordance with the philosophy developed for the ECAM system.

A description of the warnings that appear in the various cases of failures detected in the ADCs or associated instruments is given in the following pages.

**ON A/C ALL

1. Air Data System Draining
   Ref. 12-24-34, P. Block 001

R 2. Air Data System Flushing

A. Reason for the Job
   Elimination of any dust or particles which may be present in pressure lines.
   Check for correct condition of pipe and hose unions.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Dry Nitrogen (2 bars = 29 psi)
(2)99A34103004000	Cover - Blanking, Static Port
(3)99A34103000000	Cover - Blanking, Static Port
(4)40006-1A44	QAD - Total Pressure System
(5)40006-1B45	QAD - Static Pressure System
(6)	Blanking Plug (MS21913D4)
Referenced Procedure	
- 32-22-11, P. Block 301	Nose Gear Main Door - (Ground Doors Opening)
- 34-10-00, P. Block 501	Flight Environment Data

C. Procedure

**ON A/C 001-003,

(Ref. Fig. 301)

**ON A/C ALL

Post SB 52-2039 For A/C 001-003,

(Ref. Fig. 302)

**ON A/C ALL

(1)Flushing of Captain and First Officer total pressure lines

NOTE : As the procedure for flushing the Captain total pressure lines is identical to that used for the First Officer total pressure lines, the procedure is described for the Captain system only. For the First Officer system, refer to information in parentheses.

(a)Job set-up

- Disconnect Captain (First Officer) total pressure hose from air data computer ADC1 (2). End of hose is red and is fitted with a Quick-Attach-Detach (QAD) connector with 2 notches.
- Connect Captain (First Officer) total pressure supply hose to nitrogen source. Attach hose to prevent movement.
- Open nose gear doors (Ref. 32-22-11, P. Block 301).
- In nose gear well, open drain valve access door.

R (b)Flushing

R 1 Flush Captain (First Officer) total pressure lines with dry nitrogen at a pressure of 2 bars (29 psi) for approximately 3 minutes. Check correct free flow and cleanliness of gas at L(R) pitot probe.

R 2 Blank L(R) pitot probe completely and press L(R) drain valve located in nose gear well to flush draining system.

R 3 Remove blanking cover from L(R) pitot probe.

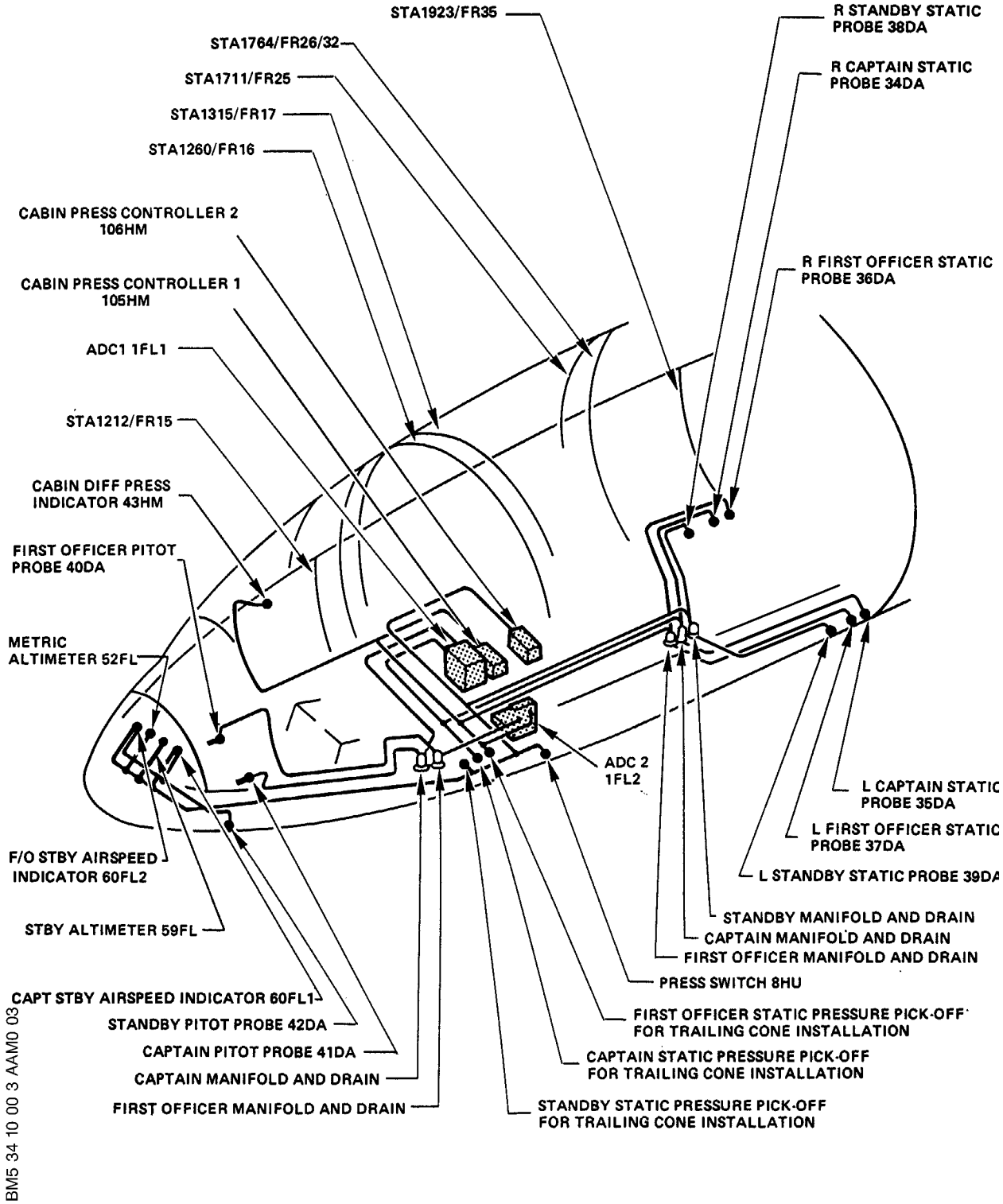
(2)Flushing of standby total pressure lines

(a)Job set-up

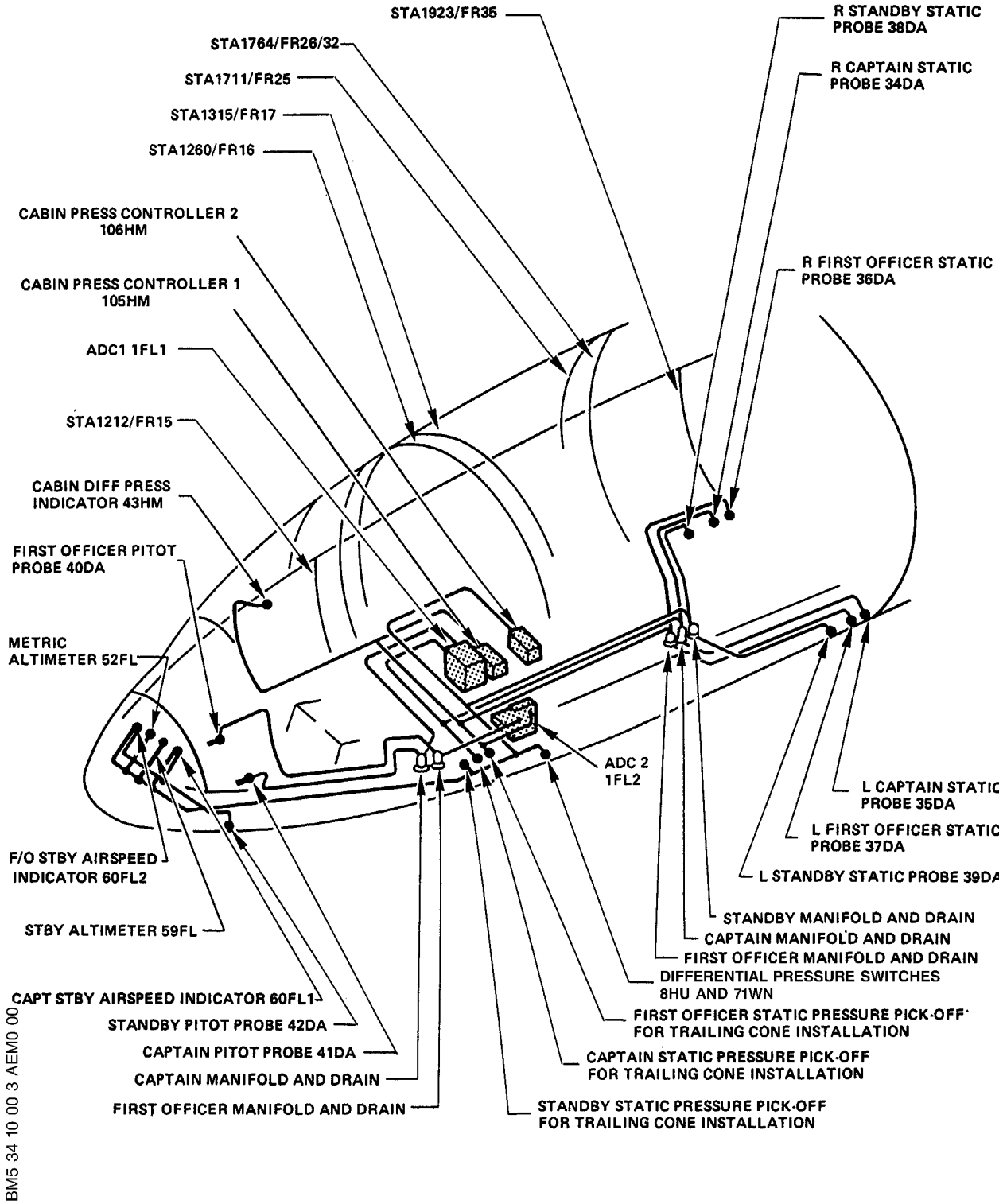
- Disconnect total pressure hoses from 2 standby airspeed indicators located on CAPT and F/O main instrument panels. End of hose is red and is fitted with a Quick-Attach-Detach (QAD) connector with 2 notches.
- Connect total pressure system QAD to either standby airspeed indicator total pressure supply hose and connect to nitrogen source. Attach hose to prevent movement.

R (b)Draining and flushing of standby pitot and static lines

R NOTE : The standby pitot lines are not fitted with drain


STA1923/FR35
STA1764/FR26/32
STA1711/FR25
STA1315/FR17
STA1260/FR16
CABIN PRESS CONTROLLER 2 106HM
CABIN PRESS CONTROLLER 1 105HM
ADC1 1FL1
STA1212/FR15
CABIN DIFF PRESS INDICATOR 43HM
FIRST OFFICER PITOT PROBE 40DA
METRIC ALTIMETER 52FL
F/O STBY AIRSPEED INDICATOR 60FL2
STBY ALTIMETER 59FL
CAPT STBY AIRSPEED INDICATOR 60FL1
STANDBY PITOT PROBE 42DA
CAPTAIN PITOT PROBE 41DA
CAPTAIN MANIFOLD AND DRAIN
FIRST OFFICER MANIFOLD AND DRAIN
R STANDBY STATIC PROBE 38DA
R CAPTAIN STATIC PROBE 34DA
R FIRST OFFICER STATIC PROBE 36DA
ADC 2 1FL2
L CAPTAIN STATIC PROBE 35DA
L FIRST OFFICER STATIC PROBE 37DA
L STANDBY STATIC PROBE 39DA
STANDBY MANIFOLD AND DRAIN
CAPTAIN MANIFOLD AND DRAIN
FIRST OFFICER MANIFOLD AND DRAIN
PRESS SWITCH 8HU
FIRST OFFICER STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
CAPTAIN STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
STANDBY STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
BM5 34 10 00 3 AAM0 03

Routing of Pressure Lines
Figure 301


STA1923/FR35
STA1764/FR26/32
STA1711/FR25
STA1315/FR17
STA1260/FR16
CABIN PRESS CONTROLLER 2 106HM
CABIN PRESS CONTROLLER 1 105HM
ADC1 1FL1
STA1212/FR15
CABIN DIFF PRESS INDICATOR 43HM
FIRST OFFICER PITOT PROBE 40DA
METRIC ALTIMETER 52FL
F/O STBY AIRSPEED INDICATOR 60FL2
STBY ALTIMETER 59FL
CAPT STBY AIRSPEED INDICATOR 60FL1
STANDBY PITOT PROBE 42DA
CAPTAIN PITOT PROBE 41DA
CAPTAIN MANIFOLD AND DRAIN
FIRST OFFICER MANIFOLD AND DRAIN
R STANDBY STATIC PROBE 38DA
R CAPTAIN STATIC PROBE 34DA
R FIRST OFFICER STATIC PROBE 36DA
ADC 2 1FL2
L CAPTAIN STATIC PROBE 35DA
L FIRST OFFICER STATIC PROBE 37DA
L STANDBY STATIC PROBE 39DA
STANDBY MANIFOLD AND DRAIN
CAPTAIN MANIFOLD AND DRAIN
FIRST OFFICER MANIFOLD AND DRAIN
DIFFERENTIAL PRESSURE SWITCHES 8HU AND 71WN
FIRST OFFICER STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
CAPTAIN STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
STANDBY STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
BM5 34 10 00 3 AEM0 00

Routing of Pressure Lines
Figure 302

R valves, the draining is ensured when the flushing is
R performed.
1 Flush standby total pressure line with dry nitrogen at a
R pressure of 2 bars (29 psi) for approximately 3 minutes.
Check correct free flow and cleanliness of gas at standby pitot probe.
R 2 Blank standby pitot probe completely and press plug on self-supply hose to flush circuit.
R 3 Remove blanking cover from standby pitot probe.

**ON A/C ALL

(3)Flushing of Captain static pressure lines
(a)Job set-up
- Disconnect Captain static pressure hose from ADC1.
End of hose is yellow and is fitted with a Quick-Attach-Detach (QAD) connector with 3 notches
- Install blanking cover on L Captain static probe.
- Connect static pressure system QAD to ADC1 static pressure supply hose and connect to nitrogen source.
Attach hose to prevent movement.

(b)Flushing
Flush Captain static pressure lines with dry nitrogen at a pressure
R of 2 bars (29 psi) for approximately 3 minutes. Check correct free flow and cleanliness of gas at following outlets :
1 R Captain static probe
2 Install blanking cover on R Captain static probe, remove blanking cover from L Captain static probe and check flow of gas at L Captain static probe.
3 Install blanking cover on L Captain static probe and press Captain static pressure system drain valve to flush draining system.
4 Remove both blanking covers from L and R Captain static probes.
(4)Flushing of First Officer static pressure lines
(a)Job set-up
- Disconnect First Officer static pressure hose from ADC2.
End of hose is yellow and is fitted with a Quick-Attach-Detach (QAD) connector with 3 notches
- Install blanking cover on R First Officer static probe
- Disconnect hose from cabin differential pressure indicator 43HM
- Disconnect hose from cabin pressure controller 1 (105HM) located on 96VU.
- Connect static pressure system QAD to ADC2 static pressure supply hose and connect to nitrogen source.
Attach hose to prevent movement.

(b)Flushing
Flush First Officer static pressure lines with dry nitrogen at a
R pressure of 2 bars (29 psi) for approximately 3 minutes. Check correct free flow and cleanliness of gas at following outlets :

1 L First Officer static probe
2 Install blanking cover on L First Officer static probe, remove blanking cover from R First Officer static probe and check flow of gas at R First Officer static probe.
3 Install blanking cover on R First Officer static probe and press First Officer static pressure system drain valve to flush draining system.
4 Press plug on self-plugging QAD of differential pressure indicator supply hose to flush circuit. Release plug.
5 Press plug on self-plugging QAD of cabin pressure controller 1 supply hose to flush circuit.
6 Remove both blanking covers from L and R First Officer static probes.

(5)Flushing of standby static pressure lines

(a)Job set-up

- Disconnect static pressure hoses from standby airspeed indicator located on CAPT and F/O main instrument panels.
  Ends of hoses are yellow and are fitted with quick attach/detach connectors (QADs) with 3 notches
- Disconnect static pressure hose from standby altimeter located on center instrument panel.
- Disconnect static pressure hose from metric standby altimeter located on CAPT main instrument panel.

**ON A/C 001-003,

- Disconnect hose from cabin pressure controller 2 (106HM) located on 92VU.
- Disconnect pipe supplying differential pressure switch (8HU) located in avionics compartment, zone 121-STA 1320 and install blanking plug.
- Install blanking cover on R standby static probe
- Connect static pressure system and connect to nitrogen source QAD to standby altimeter supply hose.
  Attach hose to prevent movement.

(b)Flushing

R Flush standby static pressure lines with dry nitrogen at a pressure of 2 bars (29 psi) for approximately 3 minutes. Check correct free flow and cleanliness of gas at following outlets :

1 L standby static probe
2 Install blanking cover on L standby probe, remove blanking cover from R standby static probe and check flow of gas at R standby static probe.
3 Install blanking cover on R standby static probe and press standby static pressure system drain valve to flush draining system.
4 Remove blanking plug from pressure switch (8HU) supply pipe and check flow of gas. Install blanking plug.
5 Press plug on self plugging QAD of cabin pressure controller 2 supply hose to flush circuit. Release plug.
6 Press plug on self plugging QAD of CAPT standby airspeed indicator supply hose to flush circuit. Release plug.
7 Press plug on self plugging QAD of F/O standby airspeed indicator

supply hose to flush circuit. Release plug.
8 Press plug on self plugging QAD standby altimeter. Release plug.
9 Remove both blanking covers from L and R standby static probes.
10 Remove blanking plug from differential pressure switch (8HU) supply pipe and connect the pipe to pressure switch.

**ON A/C ALL

Post SB 52-2039 For A/C 001-003,

- Disconnect hose from cabin pressure controller 2 (106HM) located on 92VU.
- Disconnect pipes supplying differential pressure switches (8HU and 71WN) located in avionics compartment zone 121-STA 1320 and install blanking plugs.
- Install blanking cover on R standby static probe
- Connect static pressure system and connect to nitrogen source QAD to standby altimeter supply hose.
  Attach hose to prevent movement.

(b)Flushing
Flush standby static pressure lines with dry nitrogen at a pressure of
R 2 bars (29 psi) for approximately 3 minutes. Check correct free flow and cleanliness of gas at following outlets :
1 L standby static probe
2 Install blanking cover on L standby probe, remove blanking cover from R standby static probe and check flow of gas at R standby static probe.
3 Install blanking cover on R standby static probe and press standby static pressure system drain valve to flush draining system.
4 Remove blanking plugs from pressure switches (8HU and 71WN) supply pipes and check flow of gas. Install blanking plugs.
5 Press plug on self plugging QAD of cabin pressure controller 2 supply hose to flush circuit. Release plug.
6 Press plug on self plugging QAD of CAPT standby airspeed indicator supply hose to flush circuit. Release plug.
7 Press plug on self plugging QAD of F/O standby airspeed indicator supply hose to flush circuit. Release plug.
8 Press plug on self plugging QAD standby altimeter. Release plug.
9 Remove both blanking covers from L and R standby static probes.
10 Remove blanking plugs from differential pressure switches (8HU and 71WN) supply pipes and connect the pipes to differential pressure switches.

**ON A/C ALL

11 Press plug on self plugging QAD of metric standby altimeter supply hose to flush circuit.

(6)Test
(a)Disconnect nitrogen equipment.

NOTE : Check that all blanking covers have been removed.

(b)Connect to appropriate instruments all pipes and hoses previously disconnected for flushing of systems.

NOTE : After the connection :

- make certain that a colored ring is shown on the QAD connector
- pull the connector to make certain that it is connected correctly.

(c)Carry out leak test (Ref. 34-10-00, P. Block 501 Para. 3 and 5) by simulating 15.000 ft flight level only.

(7)Close-Up

(a)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(b)Remove all ground handling and maintenance equipment, standard and special tools, together with ground power and replenishing equipment, all access equipment and miscellaneous items.

(c)In nose gear well:

- close drain valve access door.

NOTE : Make certain that the clip of the ball chain or the drain valve access door does not press the L (R) drain valve.

(d)Close nose gear doors (Ref. 32-22-11, P. Block 301).

3. Cleaning of the Pitot Probe Drain Holes

A. Reason for the Job

Elimination of any dust or particles which may be present in pitot probe drain hole and in pneumatic lines:

- Cleaning of Captain pitot probe drain holes.
- Cleaning of First Officer pitot probe drain holes.
- Cleaning of standby pitot probe drain holes.

B. Equipment and Materials

	ITEM	DESIGNATION
	(1)	Access Platform, 3.00 m (10 ft.)
	(2)	Circuit Breaker Safety Clips
R	(3)	Wire - Nylon, dia. 0.6 mm (0.023 in.)
R	(4)	Wire - Nylon, dia. 0.7 mm (0.027 in.)
	(5)	Dry Nitrogen (2 bars = 29 psi)
	(6)40006-1A44	QAD - Total Pressure System
	(7)40006-1B45	QAD - Static Pressure System
	(8)98D34103004001	Cleaner Kit - Pitot Probe
	Referenced Procedure	
	- 32-22-11, P. Block 301	Nose Gear Main Door - (Ground Doors Opening)
	- 34-10-00, P. Block 501	Flight Environment Data

C. Cleaning of Captain Pitot Probe Drain Holes

(1)Job Set-Up
(a)Put access platform in position and open access door 121BL to gain access to Captain pitot probe 41DA.
(b)Disconnect Captain total pressure hose from Air Data Computer ADC1. End of hose is red and is fitted with a Quick-Attach-Detach (QAD) connector with 2 notches.
(c)Connect Captain total pressure supply hose to nitrogen source.
(d)Attach hose to prevent movement.
(e)Open nose gear doors (Ref. 32-22-11, P. Block 301).
(f)In nose gear well, open drain valve access door.

(2)Cleaning of the pitot probe drain holes
(a)Blow the gas into the hose at a pressure of 2 bars (29 psi) for
R approximately 3 minutes, and, at the same time:
- clean draining hole of the Captain pitot probe 41DA with pitot
R probe cleaner kit (98D34103004001) and nylon wires, dia. 0.6 mm
R (0.023 in.) and 0.7 mm (0.027 in.).
- Make sure that there is no contamination in the pressurized gas at the outlet of the Captain pitot probe 41DA.
- Stop the flow of gas.

R (3)After the cleaning procedure

R WARNING : IF ONE OR MORE QUICK-DISCONNECT COUPLINGS ARE DISCONNECTED IN
R ONE SYSTEM, MAKE SURE THAT A SECOND QUALIFIED MECHANIC DOES A
R VISUAL INSPECTION OF THE QUICK-DISCONNECT COUPLING CONNECTIONS.
R THE TWO MECHANICS MUST SIGN OFF THE JOB.
R IF ONE OR MORE QUICK-DISCONNECT COUPLINGS ARE DISCONNECTED
R IN TWO OR MORE SYSTEMS, MAKE SURE THAT A SECOND QUALIFIED
R MECHANIC DOES A VISUAL INSPECTION OF THE QUICK-DISCONNECT
R COUPLING CONNECTIONS AND DOES THE LEAK TEST. THE TWO MECHANICS
R MUST SIGN OFF THE JOB.

(a)If one quick-disconnect coupling is disconnected in one total pressure line, a second qualified mechanic must do a visual inspection of the quick-disconnect coupling.
(b)If two (or more) quick-disconnect couplings are disconnected in two (or more) total pressure lines:
- A second qualified mechanic must do a visual inspection of the quick-disconnect coupling connections.
- Do the leak test of the Total Air Data System (Ref. 34-10-00, P. Block 501).
- The two mechanics must sign off the job.

D. Cleaning of First Officer Pitot Probe Drain Holes

(1)Job Set-Up
(a)Put access platform in position and open access door 121BL to gain access to First Officer pitot probe 40DA.
(b)Disconnect First Officer total pressure hose from ADC2. End of hose

is red and is fitted with a QAD connector with 2 notches.
(c)Connect First Officer total pressure supply hose to nitrogen source.
(d)Attach hose to prevent movement.
(e)Open nose gear doors (Ref. 32-22-11, P. Block 301).
(f)In nose gear well, open drain valve access door.

(2)Cleaning of the pitot probe drain holes
(a)Blow the gas into the hose at a pressure of 2 bars (29 psi) for
R approximately 3 minutes, and, at the same time:
- clean draining hole of the First Officer pitot probe 40DA with
R pitot probe cleaner kit (98D34103004001) and nylon wires, dia.
R 0.6 mm (0.023 in.) and 0.7 mm (0.027 in.).
- Make sure that there is no contamination in the pressurized gas at the outlet of the First Officer pitot probe 40DA.
- Stop the flow of gas.
R (3)After the cleaning procedure

R WARNING : IF ONE OR MORE QUICK-DISCONNECT COUPLINGS ARE DISCONNECTED IN
R ONE SYSTEM, MAKE SURE THAT A SECOND QUALIFIED MECHANIC DOES A
R VISUAL INSPECTION OF THE QUICK-DISCONNECT COUPLING CONNECTIONS.
R THE TWO MECHANICS MUST SIGN OFF THE JOB.
R IF ONE OR MORE QUICK-DISCONNECT COUPLINGS ARE DISCONNECTED
R IN TWO OR MORE SYSTEMS, MAKE SURE THAT A SECOND QUALIFIED
R MECHANIC DOES A VISUAL INSPECTION OF THE QUICK-DISCONNECT
R COUPLING CONNECTIONS AND DOES THE LEAK TEST. THE TWO MECHANICS
R MUST SIGN OFF THE JOB.

(a)If one quick-disconnect coupling is disconnected in one total pressure line, a second qualified mechanic must do a visual inspection of the quick-disconnect coupling.
(b)If two (or more) quick-disconnect couplings are disconnected in two (or more) total pressure lines:
- A second qualified mechanic must do a visual inspection of the quick-disconnect coupling connections.
- Do the leak test of the Total Air Data System (Ref. 34-10-00, P. Block 501).
- The two mechanics must sign off the job.

E. Cleaning of Standby Pitot Probe Drain Holes

(1)Job Set-Up
(a)Put access platform in position and open access door 121BL to gain access to standby pitot probe 42DA.
(b)Disconnect total pressure hoses from 2 standby airspeed indicators located on CAPT and F/O main instrument panels.
End of hose is red and is fitted with a QAD connector with 2 notches.
(c)Connect total pressure system QAD to either standby airspeed indicator total pressure supply hose and connect to nitrogen source.
(d)Attach hose to prevent movement.

(2)Cleaning of the pitot probe drain holes
(a)Blow the gas into the hose at a pressure of 2 bars (29 psi) for
R approximately 3 minutes, and, at the same time:
- clean draining hole of the standby pitot probe 42DA with pitot
R probe cleaner kit (98D34103004001) and nylon wires, dia. 0.6 mm
R (0.023 in.) and 0.7 mm (0.027 in.).
- Make sure that there is no contamination in the pressurized gas at the outlet of the standby pitot probe 42DA.
- Stop the flow of gas.
R (3)After the cleaning procedure

R WARNING : IF ONE OR MORE QUICK-DISCONNECT COUPLINGS ARE DISCONNECTED IN
R ONE SYSTEM, MAKE SURE THAT A SECOND QUALIFIED MECHANIC DOES A
R VISUAL INSPECTION OF THE QUICK-DISCONNECT COUPLING CONNECTIONS.
R THE TWO MECHANICS MUST SIGN OFF THE JOB.
R IF ONE OR MORE QUICK-DISCONNECT COUPLINGS ARE DISCONNECTED
R IN TWO OR MORE SYSTEMS, MAKE SURE THAT A SECOND QUALIFIED
R MECHANIC DOES A VISUAL INSPECTION OF THE QUICK-DISCONNECT
R COUPLING CONNECTIONS AND DOES THE LEAK TEST. THE TWO MECHANICS
R MUST SIGN OFF THE JOB.

(a)If one quick-disconnect coupling is disconnected in one total pressure line, a second qualified mechanic must do a visual inspection of the quick-disconnect coupling.
(b)If two (or more) quick-disconnect couplings are disconnected in two (or more) total pressure lines:
- A second qualified mechanic must do a visual inspection of the quick-disconnect coupling connections.
- Do the leak test of the Total Air Data System (Ref. 34-10-00, P. Block 501).
- The two mechanics must sign off the job.

F. Close-Up
(a)Make sure that working area is clean and clear of tools and miscellaneous items of equipment.
(b)Remove all ground handling and maintenance equipment, standard and special tools, together with ground power and replenishing equipment, all access equipment and miscellaneous items.
(c)In nose gear well:
- close drain valve access door.
NOTE : Make sure that the clip of the ball chain or the drain valve access door does not press the L (R) drain valve.
(d)Close nose gear doors (Ref. 32-22-11, P. Block 301).

1. Operational Test

A. BITE Test

(1)Reason for the job

- to check flight environment parameters and Vz function with IRS off,
- to perform operational test of VMO/MMO overspeed warning using ADS/SYS pushbutton switches on lateral panel.

(2)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

**ON A/C 005-200,

WARNING : BEFORE TEST IS INITIATED, MAKE SURE THAT THE ATC/TCAS CONTROL PANEL IS SET TO STANDBY MODE.

**ON A/C ALL

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Make certain that electronics racks ventilation is correct.
3 Make certain that overhead panel circuit breakers are closed, particularly those following NAVIGATION, ADS and ECAM ones :
- on 21VU, lines 104, 105, 108 and 109
- on 22VU, line 208

4 Make certain that EFIS SGU switching and ADC INST switching are in normal position.
5 Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (lines 331 and 332) (aircraft in ground configuration).
6 On ECAM control panel press CLR pushbutton switch until MASTER CAUTION and MASTER WARN lights on panels 3VU and 5VU go off and MEMO page is displayed on left ECAM display unit.
7 Make certain that AFS is not energized, PITCH TRIM and YAW DAMPER levers not engaged.
8 On overhead panel check that MSU1(2) mode selector switch is in OFF position.

**ON A/C 001-003,

9 On CAPT (F/O) VSI, make certain that IVS flag is in view.

10 On CAPT (F/O) EFIS control panel, check that MODE selector switch is not PLAN position.

**ON A/C 004-200,

9 On CAPT(F/O) VSI/TCAS, make certain that IVS flag is in view on the upper left corner.
10 On CAPT(F/O) EFIS control panel, check that MODE selector switch is not in PLAN position.

**ON A/C ALL

NOTE : The following test is valid for Captain system, for F/O system read information in parentheses.

(b)Test

ACTION	RESULT
On maintenance panel 47OVU 1. Press ADS/SYS1(2) pushbutton switch	Check that : - On maintenance panel 47OVU . ADS/SYS1(2) TEST legend is on Check on indicators that for about 5 s. : - On Captain (F/O) PFD . symbols displayed on the air-speed scale are cleared . airspeed scale turns red . red SPD failure warning message flashes for a few seconds - On Captain (F/O) ND . on upper left corner TAS symbol disappears for a few seconds. - On Captain (F/O) altimeter . OFF warning flag covers drum display
**ON A/C 001-003,	- On Captain (F/O) VSI . OFF flag comes into view
**ON A/C 004-200,	- On CAPT(F/O) VSI/TCAS . V/S flag comes into view.
**ON A/C ALL	- On CAPT and F/O main instrument panels 3VU and 5VU . MASTER CAUTION lights come on for a few seconds and single chime

ACTION	RESULT
	sounds. - On left ECAM Display Unit the following message appears for a few seconds : NAV ADC ADC1 (2) FAULT - On main instrument panel all flags and warnings listed above go out of view and the following values are displayed on Captain (F/O) instrument panel. . on PFD : CAS 367 kts ± 1 MACH 0.660 ± 0.010 . on ND : TAS 433 kts ± 1 . on altimeter : Hp 10 000 ft ± 30
**ON A/C 001-003,	
	- On VSI pointer goes to 600 ft./mn in climb for a few seconds.
**ON A/C 004-200,	
	- On VSI/TCAS, the pointer goes to 600 ft./mn in climb for a few seconds.
**ON A/C ALL	
2. On ECAM control panel press CLR push-button switch until the following page is displayed : - MEMO on left ECAM display unit (Ref. NOTE).	On left ECAM display unit the following TAT value appears : 35°C ±2

R NOTE : Display of TAT from ADC2 is possible only if ADS/ADC1/
R 115VAC circuit breaker 9FL1 is opened (panel 22VU, 208/B19).
R Display of TAT from ADC1 is possible only if ADS/ADC2/115VAC
R circuit breaker 9FL2 is opened (panel 21VU, 105/E10).

**ON A/C 101-200,	
3. On maintenance panel 47OVU, press and hold ECAM/INHIB OVRD pushbutton switch for 2 seconds.	- MASTER WARN lights on panels 3VU and 5VU flash and continuous repetitive chime is heard. - On left ECAM Display Unit the following message appears :

ACTION	RESULT
	OVERSPEED VLE 270 VMO/MMO 340/.84
**ON A/C 001-100,	
3. On maintenance panel 470VU, press and hold ECAM/INHIB OVRD pushbutton switch for 2 seconds.	- MASTER WARN lights on panels 3VU and 5VU flash and continuous repetitive chime is heard. - On left ECAM Display Unit the following message appears : OVERSPEED VLE 270 VMO/MMO 340/.84
**ON A/C ALL	
4. Press CLR pushbutton switch on the ECAM control panel until MASTER WARN lights go off and the continuous repetitive chime stops sounding.	MEMO page on left ECAM unit displayed.
5. Release ADS/SYS1(2) pushbutton switch	- ADS/SYS1(2) TEST legend goes off - Altimeter flag comes into view until the indicators come to a standstill and then goes out of view

(c)Close-up
1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Close circuit breakers 9FL1, 9FL2.
3 Restore system and aircraft to normal operating condition.

B. Operational Check of DADC Switching
(1)Equipment and Materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(2)Procedure
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that overhead panel circuit breakers are closed particularly those associated with **ADS** and **NAVIGATION** (panel 21VU, lines 104 and 105).

4 Make certain that **EFIS SGU** switching and **ADC INST** switching are in normal position.

5 Close **L/G PROX DET & RELAYS** circuit breakers on panel 133VU lines 331 and 332) (aircraft in ground configuration).

6 On **ECAM** control panel press **CLR** pushbutton switch until **MASTER CAUTION** and **MASTER WARN** lights on panels 3VU and 5VU go off and **MEMO** page is displayed on left **ECAM** display unit.

7 Make certain that **AFS** is not energized, **PITCH TRIM** and **YAW DAMPER** levers not engaged.

8 On overhead panel, check that **MSU1 (2)** mode selector switch is in **OFF** position.

NOTE : The following test is valid for Captain switching, for F/O switching read information in parentheses.

(b)Test

ACTION	RESULT
1. On overhead circuit breaker panel 22VU (21VU) - open, safety and tag **ADC1(2)** circuit breaker **9FL1(2) 208/B19 (105/E10)**	On Captain (F/O) main instrument panel check that : - On **PFD** . symbols displayed on airspeed scale are cleared . airspeed scale turns red . red **SPD** failure warning message flashes for a few seconds. - On **ND** . **TAS** symbol disappears. - On altimeter . **OFF** shutter covers drum display
**ON A/C 001-003,	- on **VSI** . **OFF** flag comes into view
**ON A/C 004-200,	- on **VSI/TCAS** . **V/S** flag comes into view in the upper left corner.
**ON A/C ALL	
2. On L (R) instrument panel 402VU (406VU)	- On L(R) instrument panel 402VU

ACTION	RESULT
press CAPT (F/O) SWITCHING/ADC INST pushbutton switch	(406VU) ADC INST/SYS2 (1) legend comes on - on R (L) instrument panel 406VU (402VU) ADC INST/CAPT/2 (F/O/1) legend comes on. - Captain (F/O) instrument flags go out of view
3. On Captain (F/O) altimeter turn BARO set knob clockwise	- on Captain (F/O) altimeter altitude value increases while F/O (Captain) altitude does not change.
4. Release CAPT (F/O) SWITCHING/ADC INST pushbutton switch	- On L(R) instrument panel 402VU (406VU) ADC INST/SYS2 (1) legend goes off. - on R (L) instrument panel 406VU (402VU) ADC INST/CAPT/2 (F/O/1) legend goes off. - On above mentioned Captain (F/O) indicators, flags come into view.
5. Close ADC1(2) circuit breaker 9FL1 (9FL2)	- All flags go out of view

(c)Close-up

1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Restore system and aircraft to normal operating condition.

R C. Recalibration of Standby Altimeter

(1)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(2)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that overhead panel circuit breakers are closed, particularly ADS/STBY ALTM circuit breaker 50 FL (panel 22VU, line 204/F19).

(b)Test

ACTION	RESULT
1. On center and Captain instrument panels select QFE on standby and metric altimeters	Check that standby altimeter displays 0 ft. (±40) and metric altimeter displays 0 m (±15).
2. On overhead circuit breaker panel 22VU, open ADS/STBY ALTM circuit breaker 50FL 204/F19	VIB flag comes into view on center instrument panel standby altimeter.
3. On Captain and F/O instrument panels, visually check standby ASI	
4. On Capt (F/O) lighting/loudspeaker panel 419VU (420VU) turn brightness knob from OFF to BRT	Check that lighting in standby altimeters and ASI increases.
5. Close circuit breaker 50FL	VIB flag goes out of view on center instrument panel standby altimeter.

(c)Close-up

1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Restore system and aircraft to normal operating condition.

2. Functional Test

**ON A/C 005-200,

WARNING : BEFORE TEST IS INITIATED, MAKE SURE THAT THE ATC/TCAS CONTROL PANEL IS SET TO STANDBY MODE.

**ON A/C ALL

A. Reason for the Job
This test is carried out in addition to the operational test to check correct operation of :
- ADC1 and ADC2 pneumatic circuits
- standby pneumatic circuit
- barometric correction
- static source error corrections (SSEC)
- OVERSPEED warning (VFE-VLE-VMO-MMO)
- Total air temperature (TAT) information
- ALPHA probes.

NOTE : Except for pneumatic circuit check, the following test will be carried out using DADC test set (35M5M01150000) as installation, starting up and handling of ground pressure generator are uneasy.

B. Test of ADC1 (ADC2) Pneumatic Circuit
(1)Test with AOA specific tool
(a)Equipment and materials

	ITEM	DESIGNATION
R	(a)36122	Adaptor-Charging, Pitot Probe
	(b)99A34103002000	Cover/Adapter - Blanking/Charging, Static Port
	(c)99A34103004000	Cover-Blanking, Static Port
	(d)	Generator-Ground Pressure with Tolerance ± 0.1 mb (0.00145 psi)
	(e)	Decade Box (300 - 600 Ohms) with a Resolution of 0.1 Ohm and Accuracy of 0.03 Ohm
	(f)	Circuit Breaker Safety Clip
	(g)	Access Platform
	(h)99A34201102000	Tool Assy - Positioning AOA Sensor
	Referenced Procedure	
	- 24-41-00, P. Block 301	AC External Power Control
	- 34-11-15, P. Block 601	Pitot Probes (40DA, 41DA and 42DA)

(b)Procedure
1 Job set-up
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

WARNING : IF NOT CORRECTLY OPERATED, THE PRESSURE GENERATOR CAN DAMAGE

SENSING DEVICES OF INSTRUMENTS. WHEN SETTING PRESSURE, DO NOT EXCEED LIMITS OF 1050MB AND 116MB AND VARIATIONS GREATER THAN 6000FT. PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHEN PRESSURE GENERATOR IS CONNECTED.

- open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/CAPT/PITOT/SUPPLY	5DA	207/C24
22VU	PROBE HEAT/CAPT/ALPHA SUPPLY	1DA	207/C25
132VU	ANTI ICE/CAPT PROBES/TAT	2DA	325/K69
132VU	ANTI ICE/PROBES CAPT/L STAT	4DA	322/N68
132VU	ANTI ICE/PROBES CAPT/R STAT	3DA	321/P69
132VU	ANTI ICE/F/O PROBES	70DA	323/M72
132VU	ANTI ICE/PROBES F/O ALPHA	51DA	323/M71
132VU	ANTI ICE/PROBES F/O/L STAT	8DA	323/M66
132VU	ANTI ICE/PROBES F/O/R STAT	7DA	322/N69
132VU	ANTI ICE/PROBES F/O/PITOT	9DA	322/N67

- energize the aircraft electrical network (Ref. 24-41-00, P. Block 301)
- make certain that electronics racks ventilation is correct
- make certain that cabin pressure control is selected in MAN mode
- close overhead panel circuit breakers particularly those associated with NAVIGATION, ADS and ECAM (see para. 1.A. (3) (a) step 3)
- remove blanking devices from Captain and First Officer static
R probes (35DA, 34DA) and (37DA, 36DA)
R - remove slip-on cover from Captain and First Officer pitot probes
R 41DA and 40DA
R - put pitot probe charging adaptor 36122 in position on Captain
R and First Officer pitot probes 41DA and 40DA
R - seal drain holes of pitot probes with a piece of plastic and
R colored adhesive tape in a highly visible manner.

R CAUTION : WHEN YOU SEAL THE DRAIN HOLE IN PITOT PROBE, DO NOT SEAL
R THE HOLE DIRECTLY WITH COLORED ADHESIVE TAPE. ALWAYS PUT
R A PIECE OF PLASTIC ON THE HOLE AND USE THE TAPE TO ATTACH
R THE PLASTIC.
R IF YOU SEAL THE DRAIN HOLE DIRECTLY WITH ADHESIVE TAPE,
R THERE IS A RISK THAT SOME OF ADHESIVE WILL STAY ON HOLE
R AND COLLECT PARTICLES. THIS CAN SUBSEQUENTLY CAUSE
R BLOCKAGE OF AND THUS INCORRECT OPERATION OF PROBE.

R - connect pressure generator to Captain and First Officer static
R probes (35DA, 34DA) and (37DA, 36DA) and to Captain and First
R Officer pitot probes 41DA and 40DA with appropriate equipment
- start up ground pressure generator
- in avionics compartment :
. remove floor panels Z121/EF and Z122/FF
. disconnect connectors 11FL1 A and 11FL2 A from total air temperature probes

. connect one decade box between terminals J and E on connector 11FL1 A and another one between terminals J and E on connector 11FL2 A
. select resistance of 500Ω on decade boxes
- close L/G PROX DET & RELAYS circuit breakers on panel 133VU (Aircraft in ground configuration)
- on ECAM control panel :
. press CLR pushbutton switch until MASTER CAUTION and MASTER WARN lights on panels 3VU and 5VU go off and MEMO page is displayed on left ECAM display unit
. using LEFT DISPLAY and RIGHT DISPLAY knobs, adjust brightness on left and right display units
- make certain that EFIS SGU switching and ADC INST switching (on panels 402VU and 406VU) are in normal position
- make certain that AFS is not energized, PITCH TRIM and YAW DAMPER levers not engaged
- on complementary navigation control panels 412VU and 413VU, using PFD and ND knobs, adjust brightness on CAPT and F/O PFDs and NDs
- make certain that flaps are retracted
- make certain that BARO set knob is pulled on Captain's (First Officer's) main altimeter
- install positioning AOA Sensor tool assy on each ALPHA probe (CAPT and F/O)
On each positioning AOA Sensor tool assy, select an angle-of-attack value of 5°

2 Test

NOTE 1 : The test described below concerns ADC1 and ADC2 pneumatic circuits.

NOTE 2 : Display of TAT information on left ECAM display unit is conditioned by MEMO page display. To enable display of this page, CLR pushbutton switch on ECAM control panel must be pressed as many times as necessary.

NOTE 3 : Display of SAT information on right ECAM display unit is conditioned by CRUISE page display. This page is displayed if the following circuit breakers are opened :

PANEL	SERVICE	IDENT.	LOCATION
21VU	ECAM/FWC1/EMER	7WW	108/B 8
21VU	ECAM/FWC2/NORM	32WW	109/A 8

NOTE 4 : Display of TAT and SAT information computed by ADC2 is possible only in case of ADC1 failure. Consequently during ADC2 test, ADC1 failure will be simulated by opening ADS/ADC1/115VAC circuit breaker 9FL1 (panel 22VU, location 208/B19).

NOTE 5 : The test must be performed with a ground pressure generator with a tolerance ± 0.1 mb (0.00145 psi).

- test with a ground pressure generator with a tolerance ± 0.1 mb

(0.00145 psi).

ACTION	RESULT
**ON A/C 101-200,	
1. On ground pressure generator - select static pressure PS of 843 mb (5000 ft.) - select impact pressure Qc of 88.4 mb (230 kts)	Check that - CAPT and F/O main altimeters display 5032 ft. ± 25 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 30 ft. - on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 231 kts ±2 . no mach indication is displayed on the bottom of the scale. - CAPT and F/O NDs display a TAS of 243 kts ±5 - left ECAM display unit displays a TAT of 0°C ±2 - right ECAM display unit displays a SAT of -8°C ±2.
2. On pressure generator - select static pressure PS of 696.8 mb (10,000 ft.) - select impact pressure Qc of 200.1 mb (340 kts) On decade box select resistance of 480Ω	Check that - CAPT and F/O main altimeters display 10,048 ft. ±30 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 35 ft. - on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 341 kts ±2 . the bottom of the scale displays a Mach indication of .614 ±.010 - CAPT and F/O NDs display a TAS of 374 kts ±5 - left ECAM display unit displays a TAT of -10°C ±2 - right ECAM display unit displays a SAT of -28°C ±2.
3. On pressure generator - select static pressure PS of 314.8 mb (29,000 ft.)	Check that - CAPT and F/O main altimeters display 29,156 ft. ±50 (BARO set

ACTION	RESULT
- select impact pressure Qc of 164.5 mb (310 kts)	knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 65 ft.
On decade box select resistance of 441Ω	- on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 312 kts ±2 . the bottom of the scale displays a Mach indication of .806 ±.010 - CAPT and F/O NDs display a TAS of 461 kts ±5 - left ECAM display unit displays a TAT of -30°C ±2 - right ECAM display unit displays a SAT of -58°C ±2.
4. On pressure generator - select static pressure PS of 196.8 mb (39,000 ft.) - select impact pressure Qc of 100 mb (244 kts)	Check that - CAPT and F/O main altimeters display 39,132 ft. ±70 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 90 ft.
On decade box select resistance of 441Ω	- on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 246 kts ±2 . the bottom of the scale displays a Mach indication of .796 ±.010 - CAPT and F/O NDs display a TAS of 456 kts ±5 - left ECAM display unit displays a TAT of -30°C ±2 - right ECAM display unit displays a SAT of -57°C ±2.
**ON A/C 001-100,	
1. On ground pressure generator - select static pressure PS of 843 mb (5000 ft.) - select impact pressure Qc of 88.4 mb (230 kts)	Check that - CAPT and F/O main altimeters display 5032 ft. ± 25 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 30 ft.

ACTION	RESULT
	- on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 231 kts ±2 . no mach indication is displayed on the bottom of the scale. - CAPT and F/O NDs display a TAS of 243 kts ±5 - left ECAM display unit displays a TAT of 0°C ±2 - right ECAM display unit displays a SAT of -8°C ±2.
2. On pressure generator - select static pressure PS of 696.8 mb (10,000 ft.) - select impact pressure Qc of 200.1 mb (340 kts)	Check that - CAPT and F/O main altimeters display 10,043 ft. ±30 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 35 ft.
On decade box select resistance of 480Ω	- on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 341 kts ±2 . the bottom of the scale displays a Mach indication of .614 ±.010 - CAPT and F/O NDs display a TAS of 374 kts ±5 - left ECAM display unit displays a TAT of -10°C ±2 - right ECAM display unit displays a SAT of -28°C ±2.
3. On pressure generator - select static pressure PS of 314.8 mb (29,000 ft.) - select impact pressure Qc of 164.5 mb (310 kts)	Check that - CAPT and F/O main altimeters display 29,139 ft. ±50 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 65 ft.
On decade box select resistance of 441Ω	- on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 312 kts ±2 . the bottom of the scale displays a Mach indication of .805 ±.010 - CAPT and F/O NDs display a TAS of

ACTION	RESULT
	461 kts ±5 - left ECAM display unit displays a TAT of -30°C ±2 - right ECAM display unit displays a SAT of -58°C ±2.
4. On pressure generator - select static pressure PS of 196.8 mb (39,000 ft.) - select impact pressure Qc of 100 mb (244 kts) On decade box select resistance of 441Ω	Check that - CAPT and F/O main altimeters display 39,117 ft. ±70 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 90 ft. - on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 246 kts ±2 . the bottom of the scale displays a Mach indication of .795 ±.010 - CAPT and F/O NDs display a TAS of 455 kts ±5 - left ECAM display unit displays a TAT of -30°C ±2 - right ECAM display unit displays a SAT of -57°C ±2.
**ON A/C ALL	
5. On pressure generator - select static pressure PS which corresponds to QFE (ambient pressure) - select impact pressure Qc of 0 mb	Rate of descent must not exceed 6000 ft. per minute.

3 Close-up

NOTE : To restore to normal condition, it is necessary to close ECAM circuit breakers 6WW, 7WW, 32WW and 33WW and eventually ADC1 circuit breaker 9FL1.

- disconnect pressure generators
- install blanking devices on Captain and First Officer static probes (35DA, 34DA) and (37DA, 36DA)
- remove adhesive tape and the piece of plastic from Captain and First Officer pitot probes 41DA and 40DA
- remove pitot probe charging adaptor 36122 from Captain and First Officer pitot probes 41DA and 40DA

R - install slip-on cover on Captain and First Officer pitot probes
R 41DA and 40DA
- de-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301)
- close circuit breakers 5DA, 1DA, 2DA, 4DA, 3DA, 70DA, 51DA, 8DA, 7DA and 9DA
- restore system and aircraft to normal operating condition.
- remove positioning AOA sensor tool assy from each ALPHA probe (CAPT and F/O)

(2)Test without AOA specific tool

(a)Equipment and materials

ITEM	DESIGNATION
R (a)36122	Adaptor-Charging, Pitot Probe
(b)99A34103002000	Cover/Adapter - Blanking/Charging, Static Port
(c)99A34103004000	Cover-Blanking, Static Port
(d)87202126V15	Generator-Ground Pressure, Type 12-3 Generator-Ground Pressure with Tolerance ≤ 0.30 mb
(e)	Decade Box (300 - 600 Ohms) with a Resolution of 0.1 Ohm and Accuracy of 0.03 Ohm
(f)	Circuit Breaker Safety Clip
(g)	Access Platform 2.5 m
(h)	Adhesive Tape - Colored
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-11-15, P. Block 601	Pitot Probes (40DA, 41DA and 42DA)

(b)Procedure

1 Job set-up

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

WARNING : IF NOT CORRECTLY OPERATED, THE PRESSURE GENERATOR CAN DAMAGE SENSING DEVICES OF INSTRUMENTS. WHEN SETTING PRESSURE, DO NOT EXCEED LIMITS OF 1050MB AND 116MB AND VARIATIONS GREATER THAN 6000FT. PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHEN PRESSURE GENERATOR IS CONNECTED.

- open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/CAPT/PITOT/SUPPLY	5DA	207/C24
22VU	PROBE HEAT/CAPT/ALPHA SUPPLY	1DA	207/C25
132VU	ANTI ICE/CAPT PROBES/TAT	2DA	325/K69
132VU	ANTI ICE/PROBES CAPT/L STAT	4DA	322/N68
132VU	ANTI ICE/PROBES CAPT/R STAT	3DA	321/P69
132VU	ANTI ICE/F/O PROBES	70DA	323/M72
132VU	ANTI ICE/PROBES F/O ALPHA	51DA	323/M71
132VU	ANTI ICE/PROBES F/O/L STAT	8DA	323/M66
132VU	ANTI ICE/PROBES F/O/R STAT	7DA	322/N69

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES F/O/PITOT	9DA	322/N67

- energize the aircraft electrical network (Ref. 24-41-00, P. Block 301)
- make certain that electronics racks ventilation is correct
- make certain that cabin pressure control is selected in MAN mode
- close overhead panel circuit breakers particularly those associated with NAVIGATION, ADS and ECAM (see para. 1.A. (3) (a) step 3).
- remove blanking devices from Captain and First Officer static
R probes (35DA, 34DA) and (37DA, 36DA)
R - remove slip-on cover from Captain and First Officer pitot
R probes 41DA and 40DA
R - put pitot probe charging adaptor 36122 in position on Captain
R and First Officer pitot probes 41DA and 40DA
R - seal drain holes of pitot probes with a piece of plastic and
R colored adhesive tape in a highly visible manner.

R CAUTION : WHEN YOU SEAL THE DRAIN HOLE IN PITOT PROBE, DO NOT SEAL
R THE HOLE DIRECTLY WITH COLORED ADHESIVE TAPE. ALWAYS PUT
R A PIECE OF PLASTIC ON THE HOLE AND USE THE TAPE TO ATTACH
R THE PLASTIC.
R IF YOU SEAL THE DRAIN HOLE DIRECTLY WITH ADHESIVE TAPE,
R THERE IS A RISK THAT SOME OF ADHESIVE WILL STAY ON HOLE
R AND COLLECT PARTICLES. THIS CAN SUBSEQUENTLY CAUSE
R BLOCKAGE OF AND THUS INCORRECT OPERATION OF PROBE.

R - connect pressure generator to Captain and First Officer static
R probes (35DA, 34DA) and (37DA, 36DA) and to Captain and First
R Officer pitot probes 41DA and 40DA with appropriate equipment
- start up ground pressure generator
- install access platform 2.5 m and put alpha probes 48FL1 and 48FL2 in nose-up position (+85°)
  . maintain alpha probe in position with colored adhesive tape
- in avionics compartment :
  . remove floor panel Z121/EF and Z122/FF
  . disconnect connectors 11FL1 A 11FL2 A from total air temperature probe
  . connect one decade box between terminals J and E on connector 11FL1 A and another one between terminals J and E on connector 11FL2 A
  . select resistance of 500Ω on decade boxes
- close L/G PROX DET & RELAYS circuit breakers on panel 133VU (Aircraft in ground configuration)
- on ECAM control panel :
  . press CLR pushbutton switch until MASTER CAUTION and MASTER WARN lights on panels 3VU and 5VU go off and MEMO page is displayed on left ECAM display unit
  . using LEFT DISPLAY and RIGHT DISPLAY knobs, adjust brightness on

left and right display units
- make certain that EFIS SGU switching and ADC INST switching (on panels 402VU and 406VU) are in normal position
- make certain that AFS is not energized, PITCH TRIM and YAW DAMPER levers not engaged
- on complementary navigation control panels 412VU and 413VU, using PFD and ND knobs, adjust brightness on CAPT and F/O PFDs and NDs.
- make certain that flaps are retracted
- make certain that BARO set knob is pulled on Captain's (First Officer's) main altimeter

2 Test

NOTE 1 : The test described below concerns ADC1 pneumatic circuit. For ADC2 pneumatic circuit test, which is identical, refer to information in parentheses.

NOTE 2 : Display of TAT information on left ECAM display unit is conditioned by MEMO page display. To enable display of this page, CLR pushbutton switch on ECAM control panel must be pressed as many times as necessary.

NOTE 3 : Display of SAT information on right ECAM display unit is conditioned by CRUISE page display. This page is displayed if the following circuit breakers are opened :

PANEL	SERVICE	IDENT.	LOCATION
21VU	ECAM/FWC1/EMER	7WW	108/B 7
21VU	ECAM/FWC2/NORM	32WW	109/A 7

NOTE 4 : Display of TAT and SAT information computed by ADC2 is possible only in case of ADC1 failure. Consequently during ADC2 test, ADC1 failure will be simulated by opening ADS/ADC1/115VAC circuit breaker 9FL1 (panel 22VU, location 208/B19).

**ON A/C 101-200,

ACTION	RESULT
1. - On ground pressure generator - select static pressure PS of 843 mb (5000 ft.) - select impact pressure Qc of 88.4 mb (230 kts)	Check that - CAPT and F/O main altimeters display 5014 ft. ± 25 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 30 ft. - on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 231 kts ±2 . no mach indication is displayed

ACTION	RESULT
	on the bottom of the scale. - CAPT and F/O NDs display a TAS of 242 kts ±5 - left ECAM display unit displays a TAT of 0°C ±2 - right ECAM display unit displays a SAT of -8°C ±2.
2. On pressure generator - select static pressure PS of 696.8 mb (10,000 ft.) - select impact pressure Qc of 200.1 mb (340 kts) On decade box select resistance of 480Ω	Check that - CAPT and F/O main altimeters display 10,288 ft. ±30 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 35 ft. - on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 346 kts ±2 . the bottom of the scale displays a Mach indication of .625 ±.010 - CAPT and F/O NDs display a TAS of 381 kts ±5 - left ECAM display unit displays a TAT of -10°C ±2 - right ECAM display unit displays a SAT of -29°C ±2.
3. On pressure generator - select static pressure PS of 314.8 mb (29,000 ft.) - select impact pressure Qc of 164.5 mb (310 kts) On decade box select resistance of 441Ω	Check that - CAPT and F/O main altimeters display 29,416 ft. ±50 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 65 ft. - on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 315 kts ±2 . the bottom of the scale displays a Mach indication of .817 ±.010 - CAPT and F/O NDs display a TAS of 467 kts ±5 - left ECAM display unit displays a TAT of -30°C ±2 - right ECAM display unit displays a SAT of -58°C ±2.

ACTION	RESULT
4. On pressure generator - select static pressure PS of 196.8 mb (39,000 ft.) - select impact pressure Qc of 100 mb (244 kts) On decade box select resistance of 441Ω	Check that - CAPT and F/O main altimeters display 39,370 ft. ±70 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 90 ft. - on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 248 kts ±2 . the bottom of the scale displays a Mach indication of .807 ±.010 - CAPT and F/O NDs display a TAS of 462 kts ±5 - left ECAM display unit displays a TAT of -30°C ±2 - right ECAM display unit displays a SAT of -58°C ±2.
**ON A/C 001-100,	
1. On ground pressure generator - select static pressure PS of 843 mb (5000 ft.) - select impact pressure Qc of 88.4 mb (230 kts)	Check that - CAPT and F/O main altimeters display 5014 ft. ± 25 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 30 ft. - on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 231 kts ±2 . no mach indication is displayed on the bottom of the scale. - CAPT and F/O NDs display a TAS of 242 kts ±5 - left ECAM display unit displays a TAT of 0°C ±2 - right ECAM display unit displays a SAT of -8°C ±2.
2. On pressure generator - select static pressure PS of 696.8 mb (10,000 ft.) - select impact pressure Qc of 200.1 mb (340 kts)	Check that - CAPT and F/O main altimeters display 10,283 ft. ±30 (BARO set knob is pulled and STD flags cover the counters)

ACTION	RESULT
	- the altitude difference between both main altimeters is lower than 35 ft.
On decade box select resistance of 480Ω	- on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 346 kts ±2 . the bottom of the scale displays a Mach indication of .625 ±.010 - CAPT and F/O NDs display a TAS of 381 kts ±5 - left ECAM display unit displays a TAT of -10°C ±2 - right ECAM display unit displays a SAT of -29°C ±2.
3. On pressure generator - select static pressure PS of 314.8 mb (29,000 ft.) - select impact pressure Qc of 164.5 mb (310 kts)	Check that - CAPT and F/O main altimeters display 29,399 ft. ±50 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 65 ft.
On decade box select resistance of 441Ω	- on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 315 kts ±2 . the bottom of the scale displays a Mach indication of .817 ± .010 - CAPT and F/O NDs display a TAS of 466 kts ±5 - left ECAM display unit displays a TAT of -30°C ±2 - right ECAM display unit displays a SAT of -58°C ±2.
4. On pressure generator - select static pressure PS of 196.8 mb (39,000 ft.) - select impact pressure Qc of 100 mb (244 kts)	Check that - CAPT and F/O main altimeters display 39,355 ft. ±70 (BARO set knob is pulled and STD flags cover the counters) - the altitude difference between both main altimeters is lower than 90 ft.
On decade box select resistance of 441Ω	- on CAPT and F/O PFDs . mobile vertical scale displays a computed airspeed (CAS) of 248 kts ±2

ACTION	RESULT
	. the bottom of the scale displays a Mach indication of .807 ±.010 - CAPT and F/O NDs display a TAS of 461 kts ±5 - left ECAM display unit displays a TAT of -30°C ±2 - right ECAM display unit displays a SAT of -58°C ±2.
**ON A/C ALL	
5. On pressure generator - select static pressure PS which corresponds to QFE (ambient pressure) - select impact pressure Qc of 0 mb	Rate of descent must not exceed 6000 ft. per minute.

3 Close-up

NOTE : To restore to normal condition, it is necessary to close ECAM circuit breakers 6WW, 7WW, 32WW and 33WW and eventually ADC1 circuit breaker 9FL1.

- disconnect pressure generator
- install blanking devices on Captain and First Officer static probes (35DA, 34DA) and (37DA, 36DA)
- remove adhesive tape and the piece of plastic from Captain and First Officer pitot probes 41DA and 40DA
- remove pitot probe charging adaptor 36122 from Captain and First Officer pitot probes 41DA and 40DA
- install slip-on cover on Captain and First Officer pitot probes 41DA and 40DA
- de-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301)
- remove colored adhesive tape from alpha probes
- remove access platform
- close circuit breakers 5DA, 1DA, 2DA, 4DA, 3DA, 70DA, 51DA, 8DA, 7DA and 9DA.
- restore system and aircraft to normal operating condition.

C. Test of Standby Pneumatic Circuit

(1)Equipment and materials

ITEM	DESIGNATION
(a)36122	Adaptor- Charging, Pitot Probe
(b)99A34103000000	Cover-Blanking, Static Port
(c)99A34103001000	Adapter-Charging, Static Port
(d)87202126V15	Generator-Ground Pressure, Type 12-3

ITEM	DESIGNATION
	Generator - Ground Pressure with Tolerance ≤ 0.30 mb.
(e)	Circuit Breaker Safety Clip
(f)	Access Platform
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(2)Procedure

(a)Job set-up

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

WARNING : IF NOT CORRECTLY OPERATED, THE PRESSURE GENERATOR CAN DAMAGE SENSING DEVICES OF INSTRUMENTS. WHEN SETTING PRESSURE, DO NOT EXCEED LIMITS OF 1050MB and 116MB AND VARIATIONS GREATER THAN 6000FT. PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHEN PRESSURE GENERATOR IS CONNECTED.

1 Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/STBY PITOT SUPPLY	55DA	207/C28
132VU	ANTI ICE/PROBES/STBY/L STAT	14DA	321/P68
132VU	ANTI ICE/PROBES/STBY/R STAT	15DA	323/M67

2 Energize the aircraft electrical network. (Ref. 24-41-00, P. Block 301).

3 Make certain that electronics racks ventilation is correct.

4 Make certain that cabin pressure control is selected in MAN mode.

5 Make certain that overhead panel circuit breakers are closed, particularly those associated with NAVIGATION, ADS and ECAM (see para. 1.A.(3) (a) step 3).

6 Make certain that AFS is not energized, PITCH TRIM and YAW DAMPER levers not engaged.

7 Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (lines 331 and 332) (Aircraft in ground configuration).

8 On ECAM control panel press CLR pushbutton switch until MASTER CAUTION and MASTER WARN lights on panels 3VU and 5VU go off and MEMO page is displayed on left ECAM display unit.

9 Start up ground pressure generator.

R 10 Remove blanking devices from standby static probes
R 39DA and 38DA.

R 11 Remove slip-on cover from standby pitot probe 42DA.

R 12 Put pitot probe charging adaptor 36122 in position on standby
R pitot probe 42DA.

R 13 Seal drain holes of pitot probe with a piece of plastic and
R colored adhesive tape in a highly visible manner.

R CAUTION : WHEN YOU SEAL THE DRAIN HOLE IN PITOT PROBE, DO NOT
R SEAL THE HOLE DIRECTLY WITH COLORED ADHESIVE TAPE. ALWAYS
R PUT A PIECE OF PLASTIC ON THE HOLE AND USE THE TAPE TO
R ATTACH THE PLASTIC.
R IF YOU SEAL THE DRAIN HOLE DIRECTLY WITH ADHESIVE TAPE,
R THERE IS A RISK THAT SOME OF ADHESIVE WILL STAY ON HOLE
R AND COLLECT PARTICLES. THIS CAN SUBSEQUENTLY CAUSE
R BLOCKAGE OF AND THUS INCORRECT OPERATION OF PROBE.

R 14 Connect pressure generator to static probes 39DA and 38DA to
R standby pitot probe 42DA with appropriate equipment.
R 15 Seal opposite static probe with appropriate equipment.

(b)Test

NOTE : Two test procedures are described :
- one with pressure generator, type 12-3
- the other with pressure generator with a tolerance ≤ 0.30 mb.

Consequently, do the procedure with the corresponding pressure generator.

1 Test performed with ground pressure generator, Type 12-3

ACTION	RESULT
1. Not applicable.	
2. On standby altimeter and on metric altimeter(s) - turn BARO set knob clockwise - turn BARO set knob counterclockwise - select barometric pressure of 1013 mb using BARO set knob	 Altitude displayed increases Altitude displayed decreases
3. On pressure generator - select static pressure PS of 1013.25 mb (0 ft.) - select impact pressure Qc of 0 mb.	- On standby altimeter . altitude displayed is 0 ft. (±40) . two barometric counters display 1013 mb and 29.92 in. Hg. . VIB flag is out of view - On metric altimeter(s) . altitude displayed is 0m (±15) . barometric counter displays 1013 mb.
4. On pressure generator : - select static pressure PS of 843 mb (5000 ft.) - select impact pressure Qc of 88.4 mb (230 kts).	- On standby altimeter altitude displayed is 5000 ft. (±50) - On metric altimeter altitude displayed is 1525 m (±20) - On CAPT and F/O standby airspeed indicators airspeed displayed is

ACTION	RESULT
	230 kts (±3).
5. On pressure generator : - select static pressure PS of 696.8 mb (10,000 ft.) - select impact pressure Qc of 200.1 mb (340 kts).	- On standby altimeter altitude displayed is 10,000 ft. (±90) - On metric altimeter altitude displayed is 3050 m (±30) - On CAPT and F/O standby airspeed indicators, airspeed displayed is 340 kts (±4).
6. On pressure generator : - select static pressure PS of 314.8 mb (29,000 ft.) - select impact pressure Qc of 164.5 mb (310 kts).	- On standby altimeter altitude displayed is 29,000 ft. (±210) - On metric altimeter altitude displayed is 8840 m (±60) - On CAPT and F/O standby airspeed indicators, airspeed displayed is 310 kts (±4).
7. On pressure generator : - select static pressure PS which corresponds to QFE (ambient pressure) - select impact pressure Qc of 0 mb.	Rate of descent must not exceed 6000 ft. per minute.

2 Test performed with ground pressure generator with a tolerance ≤ 0.30 mb.

ACTION	RESULT
1. Not applicable.	
2. On standby altimeter and on metric altimeter(s) - turn **BARO** set knob clockwise - turn **BARO** set knob counterclockwise - select barometric pressure of 1013 mb using **BARO** set knob	Altitude displayed increases Altitude displayed decreases
3. On pressure generator - select static pressure PS of 1013.25 mb (0 ft.) - select impact pressure Qc of 0 mb.	- On standby altimeter . altitude displayed is 0 ft. (±40) . two barometric counters display 1013 mb and 29.92 in. Hg. - On metric altimeter(s) . altitude displayed is 0m (±15) . barometric counter displays 1013 mb.
4. On pressure generator : - select static pressure PS of 843 mb (5000 ft.) - select impact pressure Qc of 88.4 mb (230 kts).	- On standby altimeter altitude displayed is 5000 ft. (±50) - On metric altimeter altitude displayed is 1525 m (±20) - On **CAPT** and **F/O** standby airspeed indicators airspeed displayed is 230 kts (±3).
5. On pressure generator : - select static pressure PS of 696.8 mb (10,000 ft.) - select impact pressure Qc of 200.1 mb (340 kts).	- On standby altimeter altitude displayed is 10,000 ft. (±71) - On metric altimeter altitude displayed is 3050 m (±30) - On **CAPT** and **F/O** standby airspeed indicators, airspeed displayed is 340 kts (±4).
6. On pressure generator : - select static pressure PS of 314.8 mb (29,000 ft.) - select impact pressure Qc of 164.5 mb (310 kts).	- On standby altimeter altitude displayed is 29,000 ft. (±121) - On metric altimeter altitude displayed is 8840 m (±60) - On **CAPT** and **F/O** standby airspeed indicators, airspeed displayed is 310 kts (±4).
7. On pressure generator : - select static pressure PS which	Rate of descent must not exceed 6000 ft. per minute.

ACTION	RESULT
corresponds to QFE (ambient pressure) - select impact pressure Qc of 0 mb.	

(c)Close-up

1 Disconnect pressure generator.

R 2 Install blanking devices on standby static probes 39DA and 38DA.

R 3 Remove adhesive tape and the piece of plastic from standby pitot probe 42DA.

R 4 Remove pitot probe charging adaptor 36122 from standby pitot probe 42DA.

R 5 Install slip-on cover on standby pitot probe 42DA.

R 6 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

R 7 Close circuit breakers 55DA, 14DA and 15DA.

R 8 Restore system and aircraft to normal operating condition.

D. Barometric Correction

(1)Equipment and materials

ITEM	DESIGNATION
(a)	Circuit Breaker Safety Clip
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(2)Procedure

(a)Job set-up

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

1 Energize the aircraft electrical network. (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that cabin pressure control is selected in MAN mode.

4 Make certain that overhead panel circuit breakers are closed, particularly those associated with NAVIGATION, ADS and ECAM (see para. 1.A.(3) (a) step 3).

5 Make certain that EFIS SGU switching and ADC INST switching on panels 402VU and 406VU are in normal position.

6 Make certain that AFS is not energized, PITCH TRIM and YAW DAMPER levers not engaged.

7 Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (lines 331 and 332) (Aircraft in ground configuration).

8 On ECAM control panel press CLR pushbutton switch until MASTER CAUTION and MASTER WARN lights on panels 3VU and 5VU go off and MEMO

page is displayed on left ECAM display unit.

(b)Test

ACTION	RESULT
On CAPT (F/O) main altimeter :	On CAPT (F/O) main altimeter :
1. Pull BARO set knob.	- STD flag covers baro set counter - Read altitude displayed.
2. Push BARO set knob.	- STD flag goes out of view.
3. Select barometric pressure of 990 mb using BARO set knob.	- Read new altitude displayed - Check that altitude has decreased by 640 ft. ± 10.
4. On Captain and First Officer main altimeters : - push BARO set knobs - select barometric pressure of 990 mb (29.23 in. Hg) On Captain main altimeter - select barometric pressure of 1013 mb (29.92 in. Hg)	- Altitudes displayed are identical. - Altitudes displayed are different.
5. On R instrument panel 406VU - press ADC INST pushbutton switch - release ADC INST pushbutton switch	- SYS1 legend comes on - On L instrument panel 402VU F/O/1 legend comes on - check that there is no change in altitude displayed on CAPT and F/O main altimeters respectively - SYS1 and F/O/1 legends go off.
6. On L instrument panel 402VU - press ADC INST pushbutton switch. - release ADC INST pushbutton switch	- SYS2 legend comes on - on R instrument panel 406VU CAPT/2 legend comes on - check that there is no change in altitude displayed on CAPT and F/O main altimeters respectively. - SYS2 and CAPT/2 legends go off.
7. On Captain and First Officer main altimeters - pull BARO set knobs	

(c)Close-up

1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Restore system and aircraft to normal operating condition.

E. Static Source Error Correction (SSEC) Test

NOTE : This test is carried out by means of DADC test set. If this test set is not available to the operator, the pressure generator must be connected to the main air data systems. (Ref. para. 2.B.)

(1)Equipment and materials

ITEM	DESIGNATION
(a)	Cart-Hydraulic Ground Power Supply
(b)35M5M01150000 or 35M5M01150001	Test Set-DADC
(c)35M5M01060000	Simulator-ALPHA Probe
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 27-50-00, P. Block 301	Flaps
- 29-10-00, P. Block 301	Main Hydraulic Power - Pressurization/ Depressurization

(2)Procedure

(a)Job Set-up

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

WARNING : FLIGHT CONTROLS MAKE CERTAIN THAT GROUND SAFETIES AND NOTICES ARE IN POSITION (Ref. 27-51-00, P. Block 301).

WARNING : BEFORE PRESSURIZING HYDRAULIC SYSTEMS MAKE CERTAIN THAT HYDRAULIC SYSTEM UNDER MAINTENANCE HAS BEEN ISOLATED.

WARNING : IF NOT CORRECTLY OPERATED, THE PRESSURE GENERATOR CAN DAMAGE SENSING DEVICES OF INSTRUMENTS. WHEN SETTING PRESSURE, DO NOT EXCEED LIMITS OF 1050MB AND 116MB AND VARIATIONS GREATER THAN 6000FT. PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHEN PRESSURE GENERATOR IS CONNECTED.

1 Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	STICK SHAKER/CAPT	12FU1	109/A 9
21VU	STICK SHAKER/F/O	12FU2	109/A10

2 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

3 Make certain that electronics racks ventilation is correct.

4 Make certain that cabin pressure control is selected in MAN mode.

5 Make certain that overhead panel circuit breakers are closed, particularly those associated with NAVIGATION, ADS and ECAM (see para. 1.A. (3) (a) step 3)

6 Make certain that EFIS SGU switching and ADC INST switching on panels 402VU and 406VU are in normal position.

7 Make certain that AFS is not energized, PITCH TRIM and YAW DAMPER levers not engaged.

8 CLose L/G PROX DET & RELAYS circuit breakers on panel 133VU (lines 331 and 332) (Aircraft in ground configuration).
9 On center pedestal, adjust L and R ECAM display unit brightness.
10 Open access door 121BL.
11 Connect DADC test set to electrical connectors 62FL1 (located in electronics rack 90VU) and 62FL2 (located in electronics rack 80VU).
On DADC test set :
- place S1 switches in OFF position
- place S2 switches in OFF position
- place S3 switches in Hp position
- place Hp/Vc RATE knobs in middle position.
12 In avionics compartment :
- disconnect connector 48FL1 A (48FL2 A) from ALPHA probe
- connect ALPHA probe simulator to connector 48FL1 A (48FL2 A)
- select an angle-of-attack value of 12°8 ± 0.5 on simulator.
13 On ECAM control panel press CLR pushbutton switch until MASTER CAUTION and MASTER WARN lights on panels 3VU and 5VU go off and MEMO page is displayed on left ECAM unit.
14 On complementary navigation control panels 412VU and 413VU, using PFD and ND knobs, adjust brightness on CAPT and F/O PFDs and NDs.
15 Pressurize hydraulic systems (Ref. 29-10-00, P. Block 301).
16 On center pedestal (panel 9VU), place flap and slat control lever in first notch (slats 0°, flaps 0°).

(b)Test

ACTION	RESULT
**ON A/C 001-100,	
1. On DADC test set - place S1 switches in ON position - place S2 switches in BIT INITIATE position - place S3 switches in Hp position - using Hp/Vc RATE knobs select an altitude of 29,400 ft. ±115 on Captain and First Officer main altimeters - place S3 switches in Vc position - using Hp/Vc RATE knobs select an airspeed of 315 kts ±2 on Captain and First Officer PFDs or On pressure generator - select static pressure PS of 314.8 mb (29,000 ft.) - select impact pressure Qc of 164.5 mb (310 kts)	On CAPT and F/O main altimeters, altitude displayed is 29,400 ft. ±115 On CAPT and F/O PFDs, airspeed displayed is 315 kts ±2.
2. On center pedestal (panel 9VU),	On Captain and First Officer main

ACTION	RESULT
- place flap and slat control lever in fourth notch (slats 20°, flaps 20°)	altimeters altitude displayed increases by 245 ft. approx. (29,645 ft. ±115).
- place flap and slat control lever in first notch (slats 0°, flaps 0°)	Altitude displayed is 29,400 ft. ±115.
**ON A/C 101-200,	
1. On DADC test set	
- place S1 switches in ON position	
- place S2 switches in BIT INITIATE position	
- place S3 switches in Hp position	
- using Hp/Vc RATE knobs select an altitude of 29,565 ft. ±115 on Captain and First Officer main altimeters	
- place S3 switches in Vc position	
- using Hp/Vc RATE knobs select an airspeed of 317 kts ±2 on Captain and First Officer PFDs	
or	
On pressure generator	
- select static pressure PS of 314.8 mb (29,000 ft.)	On CAPT and F/O main altimeters, altitude displayed is 29,415 ft. ±115
- select impact pressure Qc of 164.5 mb (310 kts)	On CAPT and F/O PFDs, airspeed displayed is 315 kts ±2.
2. On center pedestal (panel 9VU),	On Captain and First Officer main altimeters altitude displayed increases by 230 ft. approx. (29,645 ft. ±115).
- place flap and slat control lever in fourth notch (slats 20°, flaps 20°)	
- place flap and slat control lever in first notch (slats 0°, flaps 0°)	Altitude displayed is 29,415 ft. ±115.
**ON A/C ALL	
3. On DADC test set	
- using Hp/Vc RATE knobs select an airspeed of 0 kt on CAPT and F/O PFDs	
- place S3 switches in Hp position	
- using Hp/Vc RATE knobs select an altitude of 0 ft. on CAPT and F/O main altimeters	

ACTION	RESULT
- place S2 and S1 switches in OFF position or On pressure generator : - select static pressure PS which corresponds to QFE (ambient pressure) - select impact pressure Qc of 0 mb.	Rate of decent must not exceed 6000 ft. per minute.

(c)Close-up

1 Disconnect DADC test set.
2 In avionics compartment, remove ALPHA probe simulator.
3 Shut down and disconnect hydraulic ground power supply cart.
4 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
5 Close circuit breakers 12FU1 and 12FU2
6 Restore system and aircraft to normal operating condition.

F. Not Applicable

G. OVERSPEED Warning Test (VFE-VLE-VMO-MMO)

NOTE 1 : This test is carried out by means of DADC test set. If this test set is not available to the operator, the pressure generator must be connected to the main air data systems. (Ref. para. 2.B.).

(1)Equipment and materials

ITEM	DESIGNATION
(a)	Cart-Hydraulic Ground Power Supply (if necessary)
(b)35M5M01150000 or 35M5M01150001	Test Set-DADC
(c)	Circuit Breaker Safety Clip
(d)	Sealing Pliers
(e)	Lockwire 0.8 mm (0.032 in.)
(f)35M5M01060000	Alpha Probes Simulator
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 27-50-00, P. Block 301	Flaps
- 29-10-00, P. Block 301	Main Hydraulic Power - Pressurization/ Depressurization

(2)Procedure

(a)Job set-up

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLA-

TED.

WARNING : FLIGHT CONTROLS MAKE CERTAIN THAT GROUND SAFETIES AND NOTICES ARE IN POSITION (Ref. 27-51-00, P. Block 301).

WARNING : BEFORE PRESSURIZING HYDRAULIC SYSTEMS MAKE CERTAIN THAT HYDRAULIC SYSTEM UNDER MAINTENANCE HAS BEEN ISOLATED.

WARNING : IF NOT CORRECTLY OPERATED, THE PRESSURE GENERATOR CAN DAMAGE SENSING DEVICES OF INSTRUMENTS. WHEN SETTING PRESSURE, DO NOT EXCEED LIMITS OF 1050MB AND 116MB AND VARIATIONS GREATER THAN 6000FT. PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHEN PRESSURE GENERATOR IS CONNECTED.

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that overhead panel circuit breakers are closed, particularly those associated with NAVIGATION, ADS and ECAM (see para. 1.A. (3) (a) step 3).

4 Make certain that EFIS SGU switching and ADC INST switching on panels 402VU and 406VU are in normal position.

5 Make certain that AFS is not energized, PITCH TRIM and YAW DAMPER levers not engaged.

6 Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (lines 331 and 332) (aircraft in ground configuration).

7 On ECAM control panel
- press CLR pushbutton switch until MASTER WARN and MASTER CAUTION lights (on panels 3VU and 5VU) go off and MEMO page is displayed on left ECAM display unit
- Using LEFT DISPLAY and RIGHT DISPLAY knobs, adjust brightness on left and right display units.

8 Open access door 121BL.

9 Connect DADC test set to electrical connectors 62FL1 (located in electronics rack 90VU) and 62FL2 (located in electronics rack 80VU).
On DADC test set
- place S1 switches in OFF position
- place S2 switches in OFF position
- place S3 switches in HP position
- place Hp/Vc rate knobs in middle position.

10 In avionics compartment
- In rack 90VU on shelf 93VU cut lockwire on L/G DOWN VMO/MMO SELECTION switch 63FL

11 On complementary navigation control panels 412VU and 413VU
- using PFD and ND knobs, adjust brightness on CAPT and F/O PFDs and NDs.

12 Pressurize hydraulic systems (Ref. 29-10-00, P. Block 301).

13 On center pedestal (panel 9VU)
- place flap and slat control lever in first notch (slats 0°, flaps 0°).

14 Connect Alpha Probes Simulator instead of Alpha Probes 48FL1 and 48FL2 and simulate an Angle of Attack less than 12°.

(b)Test

NOTE : The test described below concerns ADC1. For ADC2 test, which

is identical, refer to information in parentheses.

WARNING : MAKE CERTAIN THAT SLATS AND FLAPS CAN BE OPERATED WITHOUT DANGER.

1 Initial conditions
- To activate MASTER WARN lights (panels 3VU and 5VU) and associated message on left ECAM display unit, press INHIB OVRD pushbutton switch on ECAM section of maintenance panel 47OVU
- On center pedestal, place flap and slat control lever in fifth notch (slats 30°, flaps 40°).
- On overhead circuit breaker panel 21VU (22VU) open ADS/ADC2/115VAC circuit breaker 9FL2 location 105/E10 (ADS/ADC1/115VAC 9FL1 location 208/B19).
- On ECAM control panel, press CLR pushbutton switch until MASTER WARN and MASTER CAUTION lights on panels 3VU and 5VU go off and MEMO page is displayed on left ECAM display unit.

2 VFE warning test
- On DADC test set side 1 (2)
  - place S1 switch in ON position
  - place S2 switch in BIT INITIATE position
  - place S3 switch in Vc position
  - using Hp/Vc RATE knob display on Captain (First Officer) PFD the airspeed values given in the table hereafter in succession
    or

  On pressure generator progressively increase impact pressure Qc to display on Captain (First Officer) PFD the airspeed values given in the table hereafter in succession.
- According to the table below, check that :
  - MASTER WARN lights flash on panels 3VU and 5VU (with continuous repetitive chime) by displaying the indicated airspeed values.
  - MASTER WARN disappears by placing flap and slat control lever in the following notch.

AIRSPEED (kts) GREATER THAN	FLAP AND SLAT Control Lever VALUES NOTCH	SLATS	FLAPS	LEFT ECAM DISPLAY UNIT
184	5	30	40	OVERSPEED VFE..... 180
	4	20	20	OVERSPEED warning disappears
199	4	20	20	OVERSPEED VFE..... 195
	3	15	15	OVERSPEED warning disappears
214	3	15	15	OVERSPEED VFE..... 210
	2	15	0	OVERSPEED warning disappears

AIRSPEED (kts) GREATER THAN	FLAP AND SLAT Control Lever NOTCH	VALUES SLATS	VALUES FLAPS	LEFT ECAM DISPLAY UNIT
249	2	15	0	OVERSPEED VFE..... 245
	1	0	0	OVERSPEED warning disappears

NOTE : To each message displayed on the L ECAM display unit is associated the MASTER WARN lights flashing on panels 3VU and 5VU.

3 VLE, VMO/MMO warning test

ACTION	RESULT
1. On DADC test set - make sure that S3 switch is in Vc position - using Hp/Vc RATE knob slowly increase the airspeed until the value 250 kts is reached on CAPT (F/O) PFD. Then increment the airspeed by steps of 5 kts approx., until the value of 280 kts is reached on CAPT (F/O) PFD. or On pressure generator, slowly increase the impact pressure Qc to display an airspeed of 250 kts on CAPT (F/O) PFD. Then increment the airspeed by steps of 5 kts approx., until the value of 280 kts is reached on CAPT (F/O) PFD. NOTE : After each step, respect a stop of 5 seconds approx.	On panels 3VU and 5VU - MASTER WARN lights flash On left ECAM display unit the following message appears OVERSPEED VLE..... 270 Continuous repetitive chime sounds.
2. On DADC test set or on pressure generator - select an airspeed of 250 kts.	OVERSPEED warning disappears. MASTER WARN lights go off.
3. On shelf 93VU of electronics rack 90VU - place L/G DOWN VMO/MMO SELECTION switch in L/G DOWN position.	

ACTION	RESULT
4. On DADC test set - using Hp/Vc RATE knob slowly increase the airspeed until the value 235 kts is reached on CAPT (F/O) PFD. Then increment the airspeed by steps of 5 kts approx., until the value of 260 kts is reached on CAPT (F/O) PFD. or On pressure generator, slowly increase the impact pressure Qc to display an airspeed of 235 kts on CAPT (F/O) PFD. Then increment the airspeed by steps of 5 kts approx., until the value of 260 kts is reached on CAPT (F/O) PFD. NOTE : After each step, respect a stop of 5 seconds approx.	On panels 3VU and 5VU - MASTER WARN lights flash. On left ECAM display unit the following message appears : OVERSPEED VMO/MMO.....255/.65 Continuous repetitive chime sounds.
5. On DADC test set or on pressure generator - select an airspeed of 250 kts.	OVERSPEED warning disappears. MASTER WARN lights go off.
6. On DADC test set - using Hp/Vc RATE knob select an airspeed of 240 kts on CAPT (F/O) PFD - place S3 switch in Hp position - using Hp/Vc RATE knob select a mach number of .66 CAPT (F/O) PFD NOTE : During this step, place S3 switch in Vc position and make sure that airspeed is lower than 255 kts on PFD. Then, place S3 switch in Hp position. or On pressure generator - decrease impact pressure (Qc) to display 240 kts on CAPT (F/O) PFD - select static pressure (PS) to display a mach number of .66 on	On panels 3VU and 5VU - MASTER WARN lights flash. On left ECAM display unit the following message appears : OVERSPEED VMO/MMO.....255/.65 Continuous repetitive chime sounds.

ACTION	RESULT
CAPT (F/O) PFD.	
7. On DADC test set - using Hp/Vc RATE knob select an altitude of 0 ft. on CAPT (F/O) main altimeter - place S3 switch in Vc position - using Hp/Vc RATE knob select an airspeed of 0 kt on CAPT (F/O) PFD - place S2 and S1 switches in OFF position or On pressure generator - select static pressure (PS) which corresponds to QFE (Ambient pressure) - select impact pressure Qc of 0 mb.	OVERSPEED warning disappears. MASTER WARN lights go off Rate of descent must not exceed 6000 ft. per minute.
8. On shelf 93VU of electronics rack 90VU - place L/G DOWN VMO/MMO SELECTION switch in NORM position. - install guard cover on switch and install lockwire.	
4 VMO warning test	

ACTION	RESULT
1. On DADC test set - place S1 switch in ON position - place S2 switch in BIT INITIATE position - make sure that S3 switch is in Vc position - using Hp/Vc RATE knob slowly increase the airspeed until the value 320 kts is reached on CAPT (F/O) PFD. Then increment the airspeed by steps of 5 kts approx. until the value of 350 kts is reached on CAPT (F/O) PFD. or On pressure generator, slowly increase the impact pressure Qc to display an airspeed of 320 kts on CAPT (F/O) PFD.	On panels 3VU and 5VU - MASTER WARN lights flash On left ECAM display unit the following message appears OVERSPEED VLE..... 270 VMO/MMO..... 340/.84 Continuous repetitive chime sounds.

ACTION	RESULT
Then increment the airspeed by steps of 5 kts approx., until the value of 350 kts is reached on CAPT (F/O) PFD. NOTE : After each step, respect a stop of 5 seconds approx.	
2. On DADC test set or on pressure generator - slowly decrease the speed until a speed below 335 kts is reached	OVERSPEED VMO/MMO warning disappears. OVERSPEED VLE warning remains displayed. MASTER WARN lights remain on.
3. On DADC test set or on pressure generator - select an airspeed below 270 kts	OVERSPEED VLE warning disappears. MASTER WARN lights go off.

5 MMO warning test

ACTION	RESULT
1. On DADC test set	On panels 3VU and 5VU
- make sure that S3 switch is in Vc position	
- using Hp/Vc RATE knob select an airspeed of 250 kts on CAPT (F/O) PFD	- MASTER WARN lights flash
- place S3 switch in Hp position and using Hp/Vc RATE knob select a mach number of .85 CAPT (F/O) PFD	On left ECAM display unit the following message appears OVERSPEED VMO/MMO..... 340/.84 Continuous repetitive chime sounds.
NOTE : During this step, place S3 switch in Vc position and make sure that airspeed is lower than 340 kts on PFD. Then, place S3 switch in Hp position.	
or On pressure generator - decrease impact pressure Qc to display 250 kts on CAPT (F/O) PFD - progressively reduce static pressure PS to display a mach number of .85 on CAPT (F/O) PFD.	
2. On DADC test set - using Hp/Vc RATE knob select an altitude of 0 ft. on CAPT (F/O)	OVERSPEED warning disappears. MASTER WARN lights go off

ACTION	RESULT
main altimeter - place S3 switch in Vc position - using Hp/Vc RATE knob select an airspeed of 0 kt on CAPT (F/O) PFD - place S2 and S1 switches in OFF position or On pressure generator : - select static pressure PS which corresponds to QFE (ambient pressure) - select impact pressure Qc of 0 mb.	Rate of descent must not exceed 6000 ft. per minute.

6 Close circuit breaker 9FL2 (9FL1)

(c)Close-up

1 Disconnect DADC test set.

2 Shut down and disconnect hydraulic ground power supply cart.

3 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

4 Restore system and aircraft to normal operating condition.

5 Make certain that L/G DOWN VMO/MMO SELECTION switch 63FL is in NORM position and that lockwire is installed.

6 Disconnect the AOA sensors simulator and connect back the alpha probes 48FL1 and 48FL2.

H. Total Air Temperature Test

(1)Equipment and materials

ITEM	DESIGNATION
(a)	Thermometer
(b)	Access Platform
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(2)Procedure

(a)Job set-up

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that overhead panel circuit breakers are closed particularly those associated with NAVIGATION, ADS and ECAM (see para. 1.A. (3) (a) step 3).

4 Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (lines 331 and 332)(aircraft in ground configuration).

5 Make certain that EFIS SGU switching and ADC INST switching (on panels 402VU and 406VU) are in normal position.
6 Make certain that PITCH TRIM lever is engaged (panel 20VU).
7 On ECAM control panel
- press CLR pushbutton switch until MASTER WARN and MASTER CAUTION lights (on panels 3VU and 5VU) go off and MEMO page is displayed on left ECAM display unit.
- using LEFT DISPLAY and RIGHT DISPLAY knobs adjust brightness on left and on right display units.

(b)Test
1 On ECAM control panel
- press as many times as necessary CLR pushbutton switch to display MEMO page.
2 Test

ACTION	RESULT
1. Using thermometer, measure temperature in the immediate vicinity of the total air temperature probe 11FL1.	On TRP and on left ECAM display unit temperature indicated must be identical with the thermometer reading ±2°C
2. On overhead circuit breaker panel 22VU open ADS/ADC1/115VAC circuit breaker 9FL1 (location 208/B19).	
3. On ECAM control panel - press as many times as necessary CLR pushbutton switch to display MEMO page.	Temperature indicated on TRP and on left ECAM display unit is identical with value previously read ±2°C.
4. Close circuit breaker 9FL1.	

(c)Close-up
1 On overhead panel
- place PITCH TRIM lever in OFF position.
2 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
3 Restore system and aircraft to normal operating condition.

I. ALPHA Probes 48FL1 and 48FL2 Test
(1)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(2)Procedure
(a)Job set-up
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT

ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

1 Make certain that the following circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
21VU	STICK SHAKER/CAPT	12FU1	109/A 9
21VU	STICK SHAKER/F/O	12FU2	109/A10

2 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
3 Make certain that electronics racks ventilation is correct.
4 Make certain that overhead panel circuit breakers are closed, particularly those associated with **NAVIGATION, ADS** and **ECAM** (see para 1. A. (3) (a) step 3)
5 Close **L/G PROX DET & RELAYS** circuit breakers on panel 133VU (lines 331 and 332) (aircraft in ground configuration).
6 Make certain that **EFIS SGU** switching and **ADC INST** switching (on panels 402VU and 406VU) are in normal position.
7 Make certain that **AFS** is not energized, **PITCH TRIM** and **YAW DAMPER** levers not engaged.

(b)Test

NOTE : Ignore the warnings and indications which are not related to this test.

ACTION	RESULT
1. On maintenance panel 47OVU - press **ALPHA PROBES/CAPT** pushbutton switch	On maintenance panel 47OVU (after 5 seconds) - **TEST** legend comes on. - On Captain and First Officer control columns, stick shaker is activated - **CRICKET** aural warning sounds In zone 122 - check that alpha probe moves.
- release **ALPLA PROBES/CAPT** pushbutton switch	- **TEST** legend goes off - stick shakers stop - aural warning stops.
2. Repeat action of step 1 using : - **ALPHA PROBES/F/O** pushbutton switch	Identical results.

(c)Close-up

1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Restore system and aircraft to normal operating condition.
3 Make sure that drain holes of pitot probes are not blocked by foreign

materials (Ref. 34-11-15, P. Block 601).

J. Test of ALPHA Probe 27CC
(Refer to procedure after Removal/Installation 22-27-39, P. Block 401)

3. Leak Test : Static System
NOTE : A 15,000 ft range leak test shall be carried out when a static check is called for by a scheduled maintenance work card, when a major repair has been accomplished on the system or when an apparent leak is present.
If the ground pressure generator is not capable of 15,000 ft, perform the leak test with 5000 ft range, but the test will be less accurate. At 5000 ft above field elevation, the leak rate tolerance is 15 ft or less in one minute.

A. Leak Test of Captain (First Officer) Static System
(1)Reason for the job
To make certain that there are no leaks in the Captain or First Officer static system (probe and associated tubing parts).
(2)Equipment and materials

ITEM	DESIGNATION
(a)99A34103002000	Cover/Adapter - Blanking/Charging, Static Port
(b)99A34103004000	Cover - Blanking, Static Port
(c)	Generator - Ground Pressure
(d)	Soap Solution
(e)	Circuit Breaker Safety Clips
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.
NOTE : The job set-up described below concerns the Captain static system leak test. For First Officer static system leak test job set-up, which is identical , refer to information between parentheses.
(a)Job set-up
1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Make certain that electronics racks ventilation is correct.
3 Make certain that overhead panel circuit breakers are closed, particularly those associated with NAVIGATION, ADS and ECAM (see para. 1. A. (3) (a) step 3).
4 Make certain that EFIS SGU switching and ADC INST switching (on panels 402VU and 406VU) are in normal position.
(b)Make certain that EFIS is operating and adjust PFD image brightness on panels 412VU and 413VU.
(c)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES CAPT/L STAT	4DA	322/N68
132VU	ANTI ICE/PROBES CAPT/R STAT	3DA	321/P69
132VU	ANTI ICE/PROBES F/O/L STAT	8DA	323/M66
132VU	ANTI ICE/PROBES F/O/R STAT	7DA	322/N69

(d)Put static test pressure generator into operation.
(e)Remove Captain and First Officer static port blanking devices.
(f)Connect pressure generator to one Captain (First Officer) static port.
(g)Seal opposite Captain (First Officer) static port with the appropriate equipment.

(4)Test

WARNING : THE ABSOLUTE PRESSURE APPLIED TO ANY STATIC SYSTEM MUST NEVER EXCEED THE AMBIENT PRESSURE WHEN ANY INSTRUMENT IS CONNECTED TO THAT STATIC SYSTEM.

WARNING : ABSOLUTE PRESSURE IN THE PITOT SYSTEM MUST NEVER BE LESS THAN THE PRESSURE IN THE STATIC SYSTEMS. THE DIFFERENCE BETWEEN PITOT AND STATIC SYSTEMS PRESSURE MUST NEVER EXCEED 527 mb (15,57 in.Hg).

WARNING : IF NOT CORRECTLY OPERATED THE PRESSURE GENERATOR CAN DAMAGE SENSING DEVICES OF INSTRUMENTS. WHEN SELECTING PRESSURE DO NOT EXCEED LIMITS OF 1050 mb AND 116 mb AND VARIATIONS GREATER THAN 6000 FEET PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHILE PRESSURE GENERATOR IS CONNECTED.

NOTE : The leak test described below concerns the Captain static system. For First Officer static system leak test, which is identical, refer to information between parentheses.

ACTION	RESULT
1. Select pressure of 1013 mb on Captain (First Officer) main altimeter.	
2. On pressure generator - select altitude of 15,000 ft. (572 mb).	
3. Close electrovalves to isolate aircraft static system from pressure generator.	After 5 minutes - check that variation in altitude does not exceed 500 ft.
4. Apply soap solution or use helium method (Refer to Para. 4.), to find leaks.	Record leaks if necessary.
5. Slowly bring pressure generator and Captain (First Officer) static system back to atmospheric pressure.	Rate of descent must not exceed 6000 ft. per minute.

(5)Close-up
(a)Disconnect pressure generator.
(b)Install Captain and First Officer static port blanking devices.
(c)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(d)Remove safety clips and tags and close circuit breakers 4DA, 3DA 8DA and 7DA.
(e)Remove ground handling and maintenance equipment, standard and special tools, together with ground power equipment, all access equipment and miscellaneous items.

B. Leak Test of Standby Static System
(1)Reason for the job
To make certain that there are no leaks in the standby static system.
(2)Equipment and materials

ITEM	DESIGNATION
(a)99A34103000000	Cover - Blanking, Static Port
(b)99A34103001000	Adapter - Charging Static Port
(c)	Generator - Ground Pressure
(d)	Soap Solution
(e)	Circuit Breaker Safety Clips
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.
(a)Job set-up
1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Make certain that electronics racks ventilation is correct.
3 Make certain that ADS/STBY ALTM circuit breaker 50 FL on panel 22VU is closed (line 204/F19).
(b)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES STBY/L STAT	14DA	321/P68
132VU	ANTI ICE/PROBES STBY/R STAT	15DA	323/M67

(c)Put static test pressure generator into operation.
(d)Remove standby static port blanking device.
(e)Connect pressure generator to one standby static port.
(f)Seal opposite standby static port with the appropriate equipment.
(4)Test
WARNING : IF NOT CORRECTLY OPERATED THE PRESSURE CAN DAMAGE SENSING DEVICES OF INSTRUMENTS. WHEN SELECTING PRESSURE DO NOT EXCEED LIMITS OF 1050 mb AND 115 mb AND VARIATIONS GREATER THAN 6000

FEET PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHILE PRESSURE GENERATOR IS CONNECTED.

ACTION	RESULT
1. Select pressure of 1013 mb on standby altimeter	
2. On pressure generator - select altitude of 15,000 ft. (572 mb).	
3. Close electrovalves to isolate aircraft static system from pressure generator	After 5 minutes - check that variation in altitude does not exceed 500 ft.
4. Apply soap solution or use helium method (Refer to Para. 4.), to find leaks.	Record leaks if necessary.
5. Slowly bring pressure generator and standby static systems pressure back to atmospheric pressure.	Rate of descent must not exceed 6000 ft. per minute.

(5)Close-up
(a)Disconnect pressure generator.
(b)Remove static port charging adapter and static port blanking cover.
(c)Install standby static port blanking devices.
(d)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(e)Remove safety clips and tags and close circuit breakers 14DA and 15DA.
(f)Remove ground handling and maintenance equipment, standard and special tools, together with ground power equipment, all access equipment and miscellaneous items.

4. Location of Leak with Helium Method : Static System
(Ref. Fig. 501)
A. Location of Leak of Captain (First Officer) Static System
NOTE : The following procedure is valid for Captain system, for F/O system read information in parentheses.
(1)Reason for the job
To find leak(s) in Captain (First Officer) static system.
(2)Equipment and materials

ITEM	DESIGNATION
(a)99A34103000000	Cover - Blanking, Static Port
(b)99A34103001000	Adapter - Charging, Static Port
(c)102-01171	Helium Detection Kit
(d)	Circuit Breaker Safety Clips
(e)98D34103002000	Adapters - Air Data System Flushing

Reference Procedure

ITEM	DESIGNATION
- 24-41-00, P. Block 301	AC External Power Control
- 34-10-00, P. Block 301	Flight Environment Data

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES CAPT/L STAT	4DA	322/N68
132VU	ANTI ICE/PROBES CAPT/R STAT	3DA	321/P69
132VU	ANTI ICE/PROBES F/O/L STAT	8DA	323/M66
132VU	ANTI ICE/PROBES F/O/R STAT	7DA	322/N69

4 Put access platform(s) in position.

5 Open access door 121BL.

6 Disconnect Quick-Attach-Detach (QAD) connector from ADC1 (ADC2) 1FL1 (1FL2).

7 Disconnect QAD connector from cabin pressure controller 1 (105HM) (for First Officer only).

8 Disconnect QAD connector from cabin differential pressure indicator (43HM) (for First Officer only).

(b)Helium pressurization

CAUTION : DURING PRESSURIZATION/DRAINING OF SYSTEM, MAKE CERTAIN THAT SNIFFER PROBE IS SET TO LOW SENSIBILITY.

NOTE : When it is possible, use the air data system flushing adapters 98D34103002000 to remove air from system.

1 Connect test set of helium detection kit to left Captain (First Officer) static probe with charging static port adapter 99A34103001000.

2 On Captain (First Officer) manifold and drain, remove air until helium is detected by sniffer probe.

3 On right Captain (First Officer) static probe, remove air until helium is detected by sniffer probe.

4 Put static port blanking cover 99A34103000000 on right Captain (First Officer) static probe.

5 On Captain (First Officer) static pressure pick-off, remove air until helium is detected by sniffer probe.

6 On QAD connector of ADC1 (ADC2) 1FL1 (1FL2), remove air until helium is detected by sniffer probe.

7 On QAD connector of cabin pressure controller 1 (105HM), remove air until helium is detected by sniffer probe (for First Officer only).

8 On QAD connector of cabin differential pressure indicator (43HM), remove air until helium is detected by sniffer probe (for First Officer only).

(c)Location of leak

NOTE : During location, make certain that pressure stays at 20mb/30mb.

NOTE : During location, make certain that sniffer probe is set to high sensibility.

1 Control Captain (First Officer) static pressure lines with sniffer probe until leak(s) is(are) detected.

2 If necessary, record or repair leak(s).

(4)Close-up

NOTE : When it is possible, use the air data system flushing adapters 98D34103002000 to drain helium from system.

(a)Disconnect test set of helium detection kit.

(b)Remove static port blanking cover from right Captain (First Officer) static probe.

(c)Flush Captain (First Officer) static pressure lines (Ref. 34-10-00, P. Block 301).

(d)Connect QAD connector to ADC1 (ADC2) 1FL1 (1FL2).

(e)Connect QAD connector to cabin differential pressure indicator (43HM) and QAD connector to cabin pressure controller 1 (105HM) (for First Officer only).

NOTE : After the connection :
- make certain that a colored ring is shown on the QAD connectors
- pull the connectors to make certain that they are connected correctly.

(f)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(g)Remove safety clips and tags and close circuit breakers 4DA, 3DA, 8DA and 7DA.

(h)Remove ground handling and maintenance equipment, standard and special tools, together with ground power equipment, all access equipment and miscellaneous items.

(j)Put aircraft back to serviceable condition.

B. Location of Leak of Standby Static System

(1)Reason for the job

To find leak(s) in Standby static system.

(2)Equipment and materials

ITEM	DESIGNATION
(a)99A34103000000	Cover - Blanking, Static Port
(b)99A34103001000	Adapter - Charging, Static Port
(c)102-01171	Helium Detection Kit
(d)	Circuit Breaker Safety Clips
(e)98D34103002000	Adapters - Air Data System Flushing
(f)	Blanking Plug (MS21913D4)
Reference Procedure	
- 24-41-00, P. Block 301	AC External Power Control
- 34-10-00, P. Block 301	Flight Environment Data

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that ADS/STBY ALTM circuit breaker on panel 22VU is closed (line 204/F19).

4 Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES STBY/L STAT	14DA	321/P68
132VU	ANTI ICE/PROBES STBY/R STAT	15DA	323/M67

5 Put access platform(s) in position.

6 Open access door 121BL.

7 Disconnect pipe(s) supplying differential pressure switch(es) 8HU (and 71WN if avalaible).

8 Install blanking plug(s) MS21913D4 on the pipe(s).

9 Disconnect QAD connector from cabin pressure controller 2 106HM.

10 Disconnect QAD connectors from Captain and First Officer standby airspeed indicators 60FL1 and 60FL2.

11 Disconnect QAD connector from standby altimeter 59FL.

12 Disconnect QAD connector(s) from metric altimeter 52FL (optional) or from metric altimeters 52FL1 and 52FL2 (optional).

(b)Helium pressurization

CAUTION : DURING PRESSURIZATION/DRAINING OF SYSTEM, MAKE CERTAIN THAT SNIFFER PROBE IS SET TO LOW SENSIBILITY.

NOTE : When it is possible, use the air data system flushing adapters 98D34103002000 to remove air from system.

1 Connect test set of helium detection kit to left standby static probe with charging static port adapter 99A34103001000.

2 On standby manifold and drain, remove air until helium is detected by sniffer probe.

3 On right standby static probe, remove air until helium is detected by sniffer probe.

4 Put static port blanking cover 99A34103000000 on right standby static probe.

5 On standby static pressure pick-off, remove air until helium is detected by sniffer probe.

6 On pipe(s) supplying differential pressure switch(es) 8HU (and 71WN if avalaible), remove air until helium is detected by sniffer probe.

7 On QAD connector of cabin pressure controller 2 106HM, remove air until helium is detected by sniffer probe.

8 On QAD connectors of Captain and First Officer standby airspeed indicators 60FL1 and 60FL2, remove air until helium is detected by sniffer probe.

9 On QAD connector of standby altimeter 59FL, remove air until helium

is detected by sniffer probe.

10 On QAD connector(s) of metric altimeter 52FL (optional) or on metric altimeters 52FL1 and 52FL2 (optional), remove air until helium is detected by sniffer probe.

(c)Location of leak

NOTE : During location, make certain that pressure stays at 20mb/30mb.

NOTE : During location, make certain that sniffer probe is set to high sensibility.

1 Control standby static pressure lines with sniffer probe until leak(s) is (are) detected.

2 If necessary, record or repair leak(s).

(4)Close-up

NOTE : When it is possible, use the air data system flushing adapters 98D34103002000 to drain helium from system.

(a)Disconnect test set of helium detection kit.

(b)Remove static port blanking cover from right standby static probe.

(c)Remove blanking plug(s) from pipe(s) supplying differential pressure switch(es) 8HU (and 71WN if available).

(d)Flush standby static pressure lines (Ref. 34-10-00,P. Block 301).

(e)Connect QAD connector to cabin pressure controller 2 106HM.

(f)Connect pipe(s) to differential pressure switch(es) 8HU (and 71WN if available).

(g)Connect QAD connectors to Captain and First Officer standby airspeed indicators 60FL1 and 60FL2.

(h)Connect QAD connector to standby altimeter 59FL.

(j)Connect QAD connector(s) to metric altimeter 52FL (optional) or to metric altimeters 52FL1 and 52FL2 (optional).

NOTE : After the connection :

- make certain that a colored ring is shown on the QAD connectors
- pull the connectors to make certain that they are connected correctly.

(k)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(l)Remove safety clips and tags and close circuit breakers 14DA and 15DA.

(m)Remove ground handling and maintenance equipment, standard and special tools, together with ground power equipment, all access equipment and miscellaneous items.

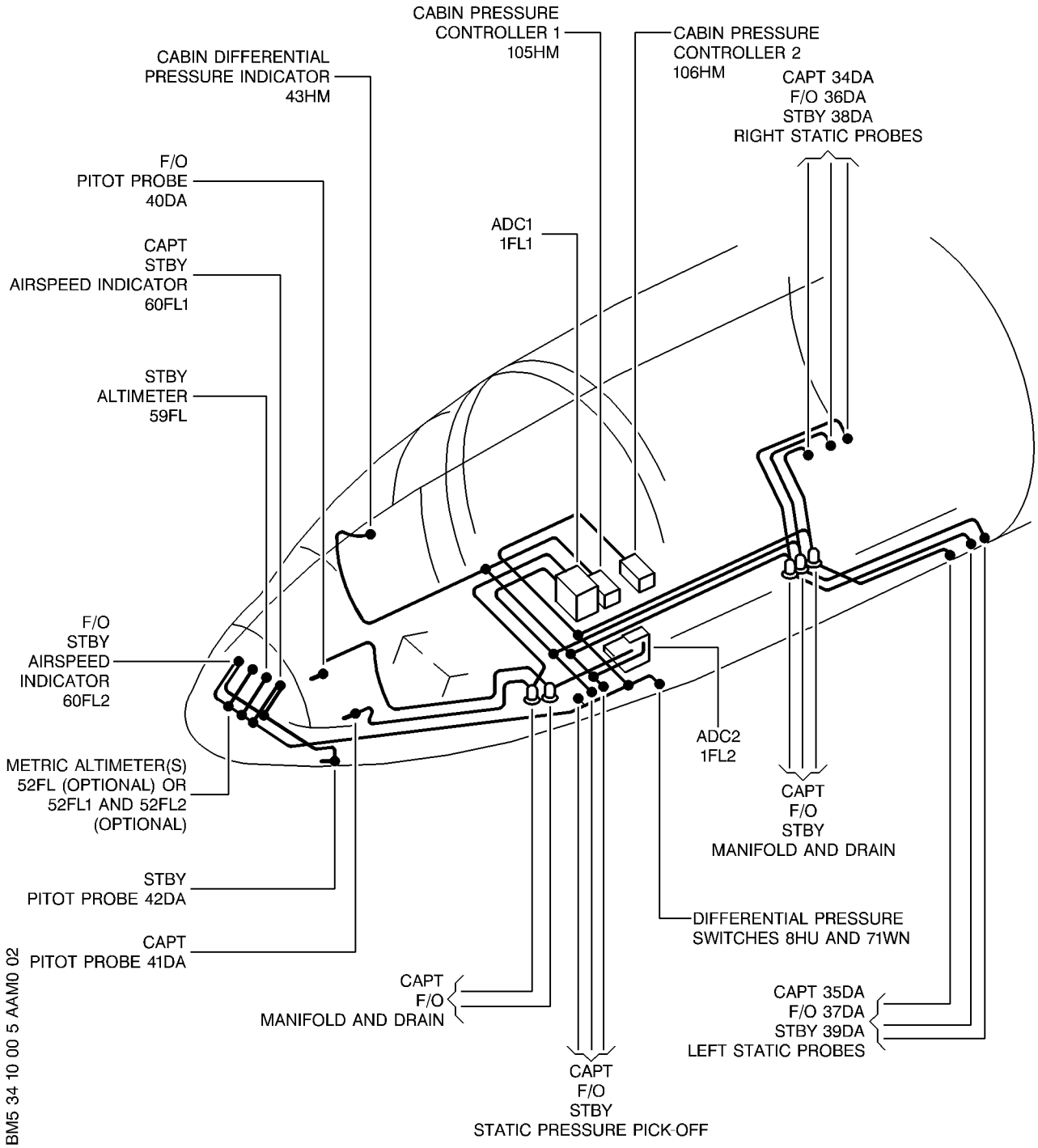
(n)Put aircraft back to serviceable condition.

5. Leak Test : Pitot System

NOTE : A 310 knot range leak test shall be carried out when a pitot check is called for by a scheduled maintenance work card, when a major repair has been accomplished on the system or when an apparent leak is present.

If the ground pressure generator is not capable of 310 knots, perform the leak test with 200 knot range.

At 200 knots, the leak rate tolerance is 0.5 knot or less in one minute.


CABIN PRESSURE CONTROLLER 1 105HM
CABIN PRESSURE CONTROLLER 2 106HM
CABIN DIFFERENTIAL PRESSURE INDICATOR 43HM
CAPT 34DA
F/O 36DA
STBY 38DA
RIGHT STATIC PROBES
F/O PITOT PROBE 40DA
ADC1 1FL1
CAPT STBY AIRSPEED INDICATOR 60FL1
STBY ALTIMETER 59FL
F/O STBY AIRSPEED INDICATOR 60FL2
ADC2 1FL2
METRIC ALTIMETER(S) 52FL (OPTIONAL) OR 52FL1 AND 52FL2 (OPTIONAL)
CAPT F/O STBY MANIFOLD AND DRAIN
STBY PITOT PROBE 42DA
DIFFERENTIAL PRESSURE SWITCHES 8HU AND 71WN
CAPT PITOT PROBE 41DA
CAPT F/O MANIFOLD AND DRAIN
CAPT 35DA F/O 37DA STBY 39DA LEFT STATIC PROBES
CAPT F/O STBY STATIC PRESSURE PICK-OFF
BM5 34 10 00 5 AAM0 02

Routing of Pressure Lines
Figure 501

A. Leak Test of Captain (First Officer) Pitot System

(1)Reason for the job

To make certain that there are no leaks in the Captain or First Officer pitot system (probe and associated tubing parts).

(2)Equipment and materials

	ITEM	DESIGNATION
R	(a)36122	Adaptor - Charging, Pitot Probe
	(b)	Generator - Ground Pressure
	(c)	Circuit Breaker Safety Clips
	(d)	Soap Solution
	(e)	Colored Adhesive Tape
	Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

NOTE : The job set-up described below concerns the Captain pitot system leak test. For First Officer pitot system leak test job set-up, which is identical , refer to information between parentheses.

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that overhead panel circuit breakers are closed, particularly those associated with NAVIGATION, ADS and ECAM (see para. 1.A. (3) (a) step 3).

4 Make certain that EFIS SGU switching and ADC INST switching (on panels 402VU and 406VU) are normal position.

(b)Make certain that EFIS is operating and adjust PFD image brightness on panels 412VU and 413VU.

(c)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/CAPT/PITOT/SUPPLY	5DA	207/C24
132VU	ANTI ICE/PROBES/F/O/PITOT	9DA	322/N67

(d)Put pitot test pressure generator into operation.

R (e)Remove slip-on cover from Captain (First Officer) pitot probe 41DA (40DA).

R (f)Put pitot probe charging adaptor 36122 in position on Captain (First Officer) pitot probe 41DA (40DA).

R (g)Seal drain holes of pitot probe with a piece of plastic and colored adhesive tape in a highly visible manner.

R CAUTION : WHEN YOU SEAL THE DRAIN HOLE IN PITOT PROBE, DO NOT SEAL THE HOLE DIRECTLY WITH COLORED ADHESIVE TAPE. ALWAYS PUT

R A PIECE OF PLASTIC ON THE HOLE AND USE THE TAPE TO ATTACH
R THE PLASTIC.
R IF YOU SEAL THE DRAIN HOLE DIRECTLY WITH ADHESIVE TAPE,
R THERE IS A RISK THAT SOME OF ADHESIVE WILL STAY ON HOLE AND
R COLLECT PARTICLES. THIS CAN SUBSEQUENTLY CAUSE BLOCKAGE OF
R AND THUS INCORRECT OPERATION OF PROBE.

R (h)Connect pressure generator to Captain (First Officer) pitot probe 41DA
R (40DA) with appropriate equipment.

(4)Test

WARNING : ANY APPLICATION OR RELEASE OF PRESSURE TO A PITOT SYSTEM MUST BE MADE SUCH THAT THE EQUIVALENT RATE OF CHANGE IS LESS THAN 300 KNOTS PER MINUTE.

WARNING : IF NOT CORRECTLY OPERATED THE PRESSURE GENERATOR CAN DAMAGE SENSING DEVICES OF INSTRUMENTS. WHEN SELECTING PRESSURE DO NOT EXCEED LIMITS OF 1050 mb AND 116 mb AND VARIATIONS GREATER THAN 6000 FEET PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHILE PRESSURE GENERATOR IS CONNECTED.

NOTE : The leak test described below concerns the Captain pitot system. For First Officer pitot system leak test, which is identical, refer to information between parentheses.

ACTION	RESULT
1. On pressure generator - select an airspeed of 310 knots.	
2. Close electrovalves to isolate aircraft pitot system from pressure generator.	After 10 minutes - check that variation in airspeed does not exceed 15 knots
3. Apply soap solution or use helium method (Refer to Para. 6.), to find leaks.	Record leaks if necessary.
4. Slowly bring pressure generator and Captain (First Officer) pitot system back to atmospheric pressure.	

(5)Close-up

(a)Disconnect pressure generator.

R (b)Remove adhesive tape and the piece of plastic from Captain
R (First Officer) pitot probe 41DA (40DA).

R (c)Remove pitot probe charging adaptor 36122 from Captain (First Officer)
R pitot probe 41DA (40DA).

R (d)Install slip-on cover on Captain (First Officer) pitot probe 41DA
R (40DA).

R (e)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

R (f)Remove safety clips and tags and close circuit breakers 5DA and 9DA.

R (g)Remove ground handling and maintenance equipment, standard and
R special tools, together with ground power equipment, all access equipment and miscellaneous items.

B. Leak Test of Standby Pitot System

(1)Reason for the job

To make certain that there are no leaks in the standby pitot system.

(2)Equipment and materials

ITEM	DESIGNATION
(a)36122	Adapter - Charging, Pitot Probe
(b)	Generator - Ground Pressure
(c)	Circuit Breaker Safety Clips
(d)	Soap Solution
(e)	Colored Adhesive Tape
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that ADS/STBY ALTM circuit breaker 50 FL on panel 22VU is closed (line 204/F19).

(b)Open, safety and tag the following circuit breaker :

PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/STBY PITOT SUPPLY	55DA	207/C28

(c)Put pitot test pressure generator into operation.

R (d)Remove slip-on cover from standby pitot probe 42DA.

R (e)Put pitot probe charging adaptor 36122 in position on standby pitot probe 42DA.

R (f)Seal drain holes of standby pitot probe with a piece of plastic and colored adhesive tape in a highly visible manner.

R CAUTION : WHEN YOU SEAL THE DRAIN HOLE IN PITOT PROBE, DO NOT SEAL
R THE HOLE DIRECTLY WITH COLORED ADHESIVE TAPE. ALWAYS PUT
R A PIECE OF PLASTIC ON THE HOLE AND USE THE TAPE TO ATTACH
R THE PLASTIC.
R IF YOU SEAL THE DRAIN HOLE DIRECTLY WITH ADHESIVE TAPE,
R THERE IS A RISK THAT SOME OF ADHESIVE WILL STAY ON HOLE AND
R COLLECT PARTICLES. THIS CAN SUBSEQUENTLY CAUSE BLOCKAGE OF
R AND THUS INCORRECT OPERATION OF PROBE.

R (g)Connect pressure generator to standby pitot probe 42DA with the appropriate equipment.

(4)Test

WARNING : IF NOT CORRECTLY OPERATED THE PRESSURE CAN DAMAGE SENSING DEVICES OF INSTRUMENTS. WHEN SELECTING PRESSURE DO NOT EXCEED LIMITS OF 1050 mb AND 115 mb AND VARIATIONS GREATER THAN 6000 FEET PER MINUTE, AND DO NOT SUDDENLY OPEN LINES TO AMBIENT AIR WHILE PRESSURE GENERATOR IS CONNECTED.

ACTION	RESULT
1. On pressure generator - select an airspeed of 310 knots.	
2. Close electrovalves to isolate aircraft pitot system from pressure generator	After 10 minutes - check that variation in airspeed does not exceed 15 knots.
3. Apply soap solution or use helium method (Refer to Para. 6.), to find leaks.	Record leaks if necessary.
4. Slowly bring pressure generator and standby pitot system pressure back to atmospheric pressure.	

(5)Close-up

(a)Disconnect pressure generator.

R (b)Remove adhesive tape and piece of plastic from standby pitot probe
R 42DA.

R (c)Remove pitot probe charging adaptor 36122 from standby pitot probe
R 42DA.

R (d)Install slip-on cover on standby pitot probe 42DA.

R (e)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

R (f)Remove safety clips and tags and close circuit breaker 55DA.

R (g)Remove ground handling and maintenance equipment, standard and special tools, together with ground power equipment, all access equipment and miscellaneous items.

6. Location of Leak with Helium Method : Pitot System

(Ref. Fig. 501)

A. Location of leak of Captain (First Officer) Pitot System

NOTE : The following procedure is valid for Captain system, for F/O system read information in parentheses.

(1)Reason for the job

To find leak(s) in Captain (First Officer) pitot system.

(2)Equipment and materials

ITEM	DESIGNATION
(a)36122	Adaptor - Charging, Pitot Probe
(b)102-01171	Helium Detection Kit
(c)	Circuit Breaker Safety Clips
(d)	Colored Adhesive Tape
(e)98D34103002000	Adapters - Air Data System Flushing
Reference Procedure	
- 24-41-00, P. Block 301	AC External Power Control
- 34-10-00, P. Block 301	Flight Environment Data

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/CAPT/PITOT/SUPPLY	5DA	207/C24
132VU	ANTI ICE/PROBES/ F/O /PITOT	9DA	322/N67

4 Put access platform(s) in position.

5 Open access door 121BL.

6 Disconnect Quick-Attach-Detach (QAD) connector from ADC1 (ADC2) 1FL1 (1FL2).

7 Put pitot probe charging adaptor 36122 in position on Captain (First Officer) pitot probe 41DA (40DA).

8 Seal drain holes of pitot probe with a piece of plastic and/or colored adhesive tape in a highly visible manner.

CAUTION : WHEN YOU SEAL THE DRAIN HOLE IN PITOT PROBE, DO NOT SEAL THE HOLE DIRECTLY WITH COLORED ADHESIVE TAPE. ALWAYS PUT A PIECE OF PLASTIC ON THE HOLE AND USE THE TAPE TO ATTACH THE PLASTIC.
IF YOU SEAL THE DRAIN HOLE DIRECTLY WITH ADHESIVE TAPE, THERE IS A RISK THAT SOME OF ADHESIVE WILL STAY ON HOLE AND COLLECT PARTICLES. THIS CAN SUBSEQUENTLY CAUSE BLOCKAGE OF AND THUS INCORRECT OPERATION OF PROBE.

(b)Helium pressurization

CAUTION : DURING PRESSURIZATION/DRAINING OF SYSTEM, MAKE CERTAIN THAT SNIFFER PROBE IS SET TO LOW SENSIBILITY.

NOTE : When it is possible, use the air data system flushing adapters 98D34103002000 to remove air from system.

1 Connect test set of helium detection kit to Captain (First Officer) pitot probe 41DA (40DA).

2 On Captain (First Officer) manifold and drain, remove air until

helium is detected by sniffer probe.
3 On QAD connector of ADC1 (ADC2) 1FL1 (1FL2), remove air until helium is detected by sniffer probe.

(c)Location of leak

NOTE : During location, make certain that pressure stays at 20mb/30mb.

NOTE : During location, make certain that sniffer probe is set to high sensibility.

1 Control Captain (First Officer) pitot pressure lines with sniffer probe until leak(s) is(are) detected.
2 If necessary, record or repair leak(s).

(4)Close-up

NOTE : When it is possible, use the air data system flushing adapters 98D34103002000 to drain helium from system.

(a)Disconnect test set of helium detection kit.
(b)Flush Captain (First Officer) pitot pressure lines (Ref. 34-10-00, P. Block 301).
(c)Connect QAD connector to ADC1 (ADC2) 1FL1 (1FL2).

NOTE : After the connection :
- make certain that a colored ring is shown on the QAD connector
- pull the connector to make certain that they are connected correctly.

R (d)Remove adhesive tape and the piece of plastic from Captain
R (First Officer) pitot probe 41DA (40DA).
R (e)Remove pitot probe charging adaptor 36122 from Captain (First Officer)
R pitot probe 41DA (40DA).
R (f)De-energize the aircraft electrical network (Ref. 24-41-00,
R P. Block 301).
R (g)Remove safety clips and tags and close circuit breakers 14DA and 15DA.
R (h)Remove ground handling and maintenance equipment, standard and special
R tools, together with ground power equipment, all access equipment and
R miscellaneous items.
(j)Put aircraft back to serviceable condition.

B. Location of Leak of Standby Pitot System

(1)Reason for the job

To find leak(s) in standby pitot system.

(2)Equipment and materials

ITEM	DESIGNATION
(a)36122	Adaptor - Charging, Pitot Probe
(b)102-01171	Helium Detection Kit
(c)	Circuit Breaker Safety Clips
(d)	Colored Adhesive Tape
(e)98D34103002000	Adapters - Air Data System Flushing
Reference Procedure	
- 24-41-00, P. Block 301	AC External Power Control
- 34-10-00, P. Block 301	Flight Environment Data

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that ADS/STBY ALTM circuit breaker on panel 22VU is closed (line 204/F19).

4 Open, safety and tag the following circuit breaker :

PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/STBY PITOT SUPPLY	55DA	207/C28

5 Put access platform(s) in position.

6 Open access door 121BL.

7 Disconnect Quick-Attach-Detach (QAD) connectors from Captain and First Officer standby airspeed indicators 60FL1 and 60FL2.

8 Put pitot probe charging 36122 adaptor in position on standby pitot probe 42DA.

9 Seal drain holes of pitot probe with a piece of plastic and/or colored adhesive tape in a highly visible manner.

CAUTION : WHEN YOU SEAL THE DRAIN HOLE IN PITOT PROBE, DO NOT SEAL THE HOLE DIRECTLY WITH COLORED ADHESIVE TAPE. ALWAYS PUT A PIECE OF PLASTIC ON THE HOLE AND USE THE TAPE TO ATTACH THE PLASTIC.
IF YOU SEAL THE DRAIN HOLE DIRECTLY WITH ADHESIVE TAPE, THERE IS A RISK THAT SOME OF ADHESIVE WILL STAY ON HOLE AND COLLECT PARTICLES. THIS CAN SUBSEQUENTLY CAUSE BLOCKAGE OF AND THUS INCORRECT OPERATION OF PROBE.

(b)Helium pressurization

CAUTION : DURING PRESSURIZATION/DRAINING OF SYSTEM, MAKE CERTAIN THAT SNIFFER PROBE IS SET TO LOW SENSIBILITY.

NOTE : Use the air data system flushing adapters 98D34103002000 to remove air from system.

1 Connect test set of helium detection kit on standby pitot probe 42DA.

2 On Captain and First Officer standby airspeed indicators 60FL1 and 60FL2, remove air until helium is detected by sniffer probe.

(c)Location of leak

NOTE : During location, make certain that pressure stays at 20mb/30mb.

NOTE : During location, make certain that sniffer probe is set to high sensibility.

1 Control standby pitot pressure lines with sniffer probe until leak(s) is(are) detected.

2 If necessary, record or repair leak(s).

(4)Close-up

NOTE : Use the air data system adapters 98D34103002000 drain helium from system.

(a)Disconnect test set of helium detection kit.

(b)Flush standby pitot pressure lines (Ref. 34-10-00, P. Block 301).

(c)Connect QAD connectors to Captain and First Officer standby airspeed indicators 60FL1 and 60FL2.
NOTE : After the connection :
- make certain that a colored ring is shown on the QAD connectors
- pull the connectors to make certain that they are connected correctly.

R (d)Remove adhesive tape and the piece of plastic from standby pitot probe
R 42DA.
R (e)Remove pitot probe charging adaptor 36122 from standby pitot probe
R 42DA.
R (f)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
R (g)Remove safety clips and tags and close circuit breaker 55DA.
R (h)Remove ground handling and maintenance equipment, standard and special tools, together with ground power equipment, all access equipment and miscellaneous items.
R (j)Put aircraft back to serviceable condition.

7. Calibration Test of the Standby Altimeter

A. Calibration Test of the Standby Altimeter

(1)Reason for the job
To calibrate the Standby Altimeter

(2)Equipment and Materials

ITEM	DESIGNATION
CMM 34-11-12 Referenced Procedure - 34-12-22, P. Block 401	Standby Altimeter (59FL) - Removal/ Installation

(3)Procedure
(a)Remove the Standby Altimeter (Ref. 34-12-22 P. Block 401).
(b)Carry out a calibration test of the Standby Altimeter (Ref. CMM 34-11-12).
(c)Install the Standby Altimeter (Ref. 34-12-22, P. Block 401).

(4)Close-up
(a)Restore system and aircraft to normal operating condition.
(b)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

8. Calibration Test of the Standby Airspeed

A. Calibration Test of the Standby Airspeed

(1)Reason for the job
To calibrate the Standby Airspeed.

(2)Equipment and Materials

ITEM	DESIGNATION
CMM 34-11-11 Referenced Procedure - 34-13-22, P. Block 401	Standby Airspeed (60FL1, 60FL2) - Removal/Installation

(3)Procedure
(a)Remove the Standby Airspeed (Ref. 34-13-22, P. Block 401).
(b)Carry out a calibration test of the Standby Airspeed (Ref. CMM 34-11-11).
(c)Install the Standby Airspeed (Ref. 34-13-22, P. Block 401).
(4)Close-up
(a)Restore system and aircraft to normal operating condition.
(b)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

R 1. General

The flight environment data is provided by three types of probes

- pressure probes (static and pitot)
- temperature probes
- alpha probes.

2. Component Location

(Ref. Fig. 001)

	FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
R	34DA	PROBE - STAT, CAPT R		136		34-11-16
R	35DA	PROBE - STAT, CAPT L		135		34-11-16
R	36DA	PROBE - STAT, F/O R		136		34-11-16
R	37DA	PROBE - STAT, F/O L		135		34-11-16
R	38DA	PROBE - STAT, STBY R		136		34-11-16
R	39DA	PROBE - STAT, STBY L		135		34-11-16
R	40DA	PROBE - PITOT, F/O		122		34-11-15
R	41DA	PROBE - PITOT, CAPT		121		34-11-15
R	42DA	PROBE - PITOT, STBY		121		34-11-15
R	27CC	PROBE - ALPHA, STBY		122		22-27-39
R	48FL1	PROBE - ALPHA, CAPT		121		34-11-19
R	48FL2	PROBE - ALPHA, F/O		122		34-11-19
R	11FL1	PROBE - TOTAL AIR TEMP, CAPT		122		34-11-18
R	11FL2	PROBE - TOTAL AIR TEMP, F/O		121		34-11-18
	1FL1	ADC - 1	96VU	122	121BL	34-11-34
	1Fl2	ADC - 2	86VU	121	121BL	34-11-34

3. Air Data Systems

A. Probes

(1)Static Pressure

Each of the three systems comprises two static probes, located on either side of the fuselage. Probe heating is achieved through an ice protection system supplied with + 28VDC.

(2)Total Pressure

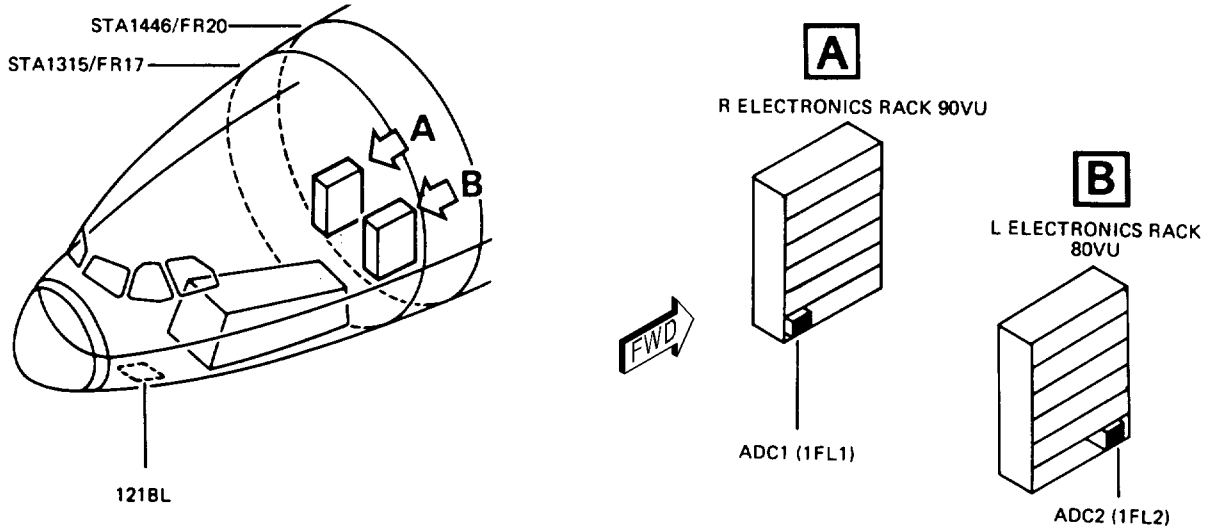
Each system comprises a pitot probe which includes an ice protection system heating circuit supplied with + 28VDC. This circuit is provided with two heating modes : high level in flight and low level on the ground.

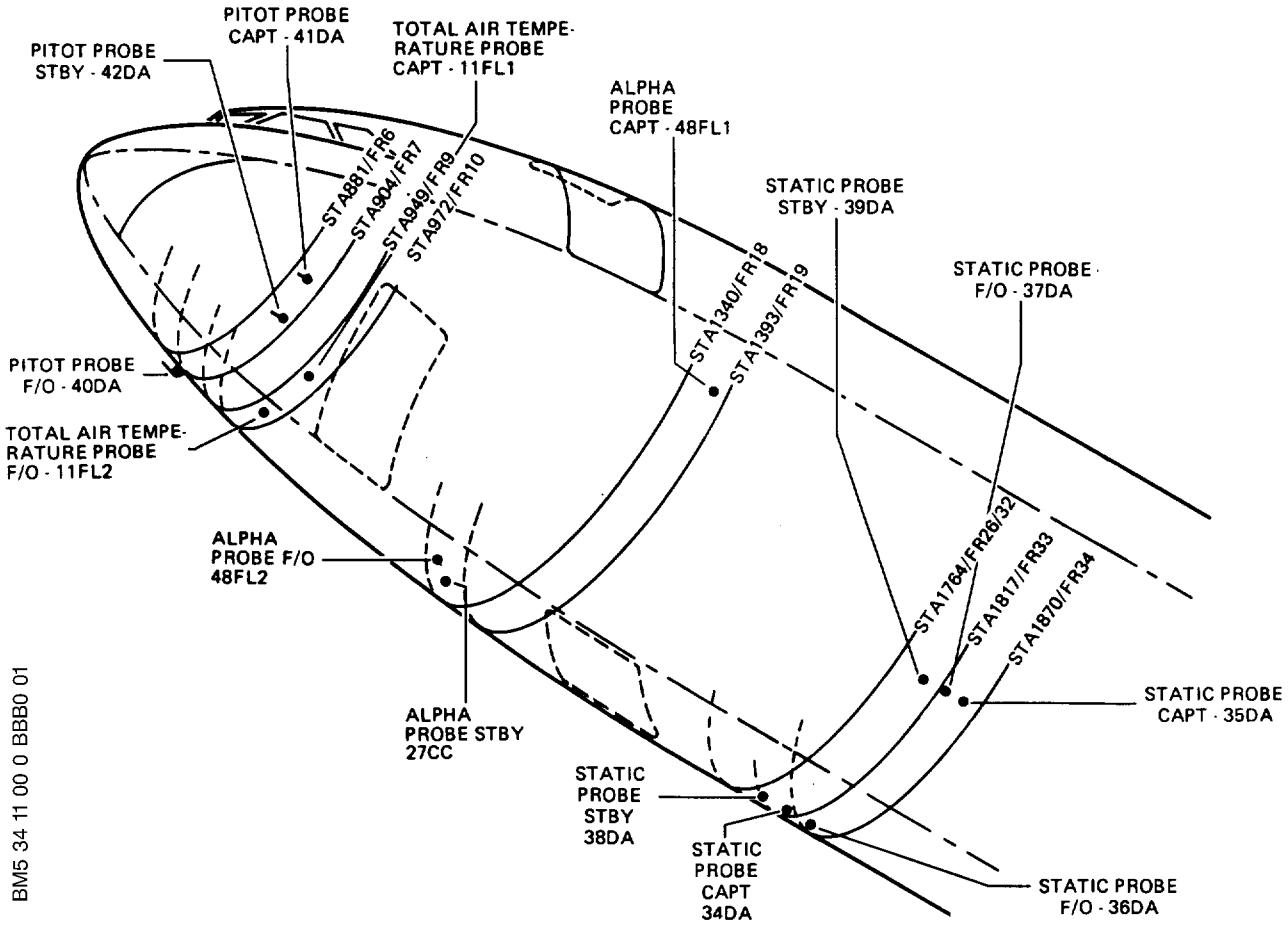
B. Pitot Static System

(Ref. Fig. 002)

The three independent static pressure and total pressure systems are made up of AG4MC (French reference) light alloy lines connected to the equipment (ADCs and associated instruments) which receive the pressure through hoses. The inner diameter of the static pressure lines is 8.4 mm, that of the total pressure lines is 6.8 mm.

The ADCs and pneumatic instruments are connected to the pressure systems by





ADS - Probes - ADC
Figure 001

R

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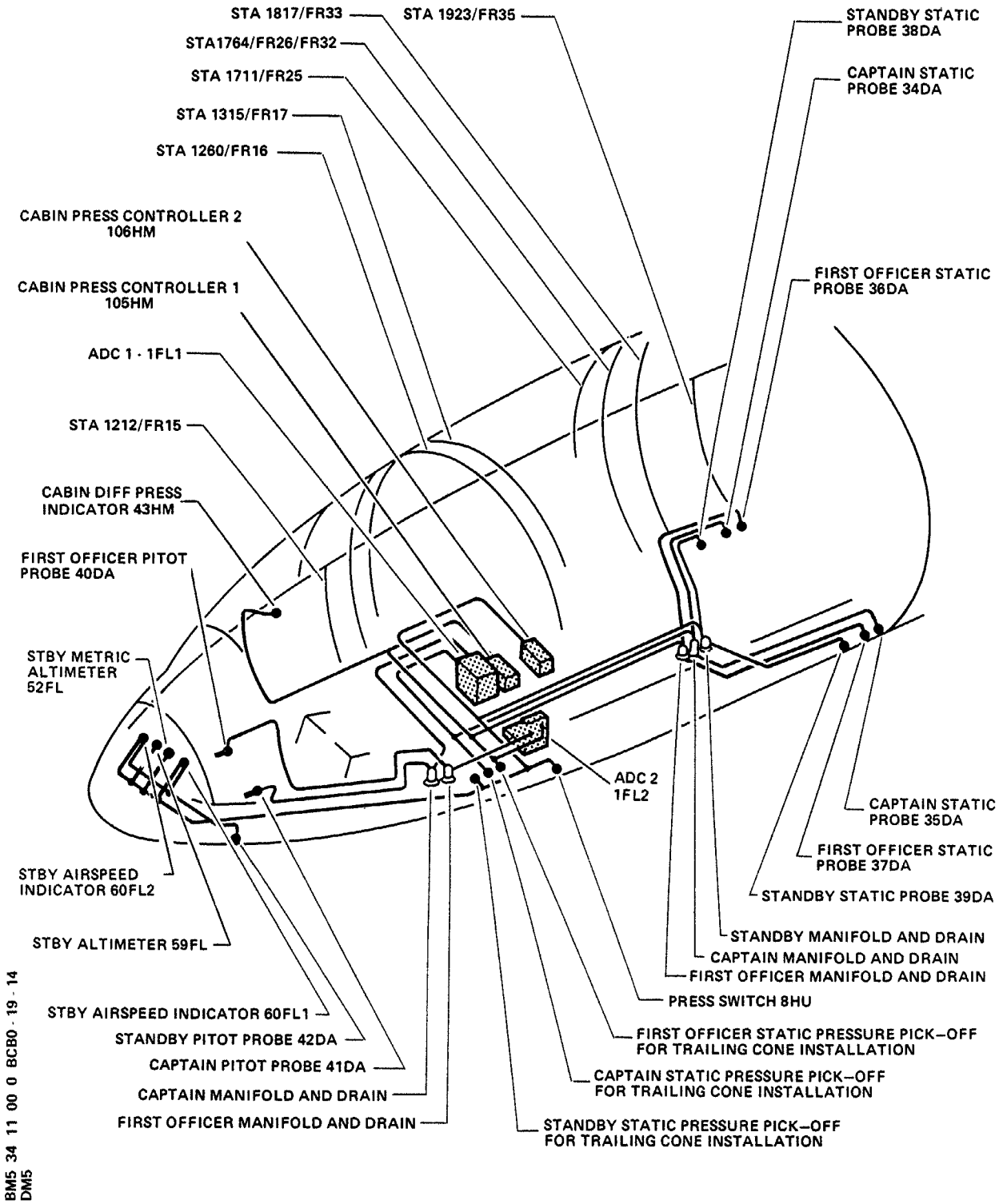
STA 1817/FR33
STA 1923/FR35
STA1764/FR26/FR32
STA 1711/FR25
STA 1315/FR17
STA 1260/FR16
CABIN PRESS CONTROLLER 2 106HM
CABIN PRESS CONTROLLER 1 105HM
ADC 1 - 1FL1
STA 1212/FR15
CABIN DIFF PRESS INDICATOR 43HM
FIRST OFFICER PITOT PROBE 40DA
STBY METRIC ALTIMETER 52FL
STBY AIRSPEED INDICATOR 60FL2
STBY ALTIMETER 59FL
STBY AIRSPEED INDICATOR 60FL1
STANDBY PITOT PROBE 42DA
CAPTAIN PITOT PROBE 41DA
CAPTAIN MANIFOLD AND DRAIN
FIRST OFFICER MANIFOLD AND DRAIN
STANDBY STATIC PROBE 38DA
CAPTAIN STATIC PROBE 34DA
FIRST OFFICER STATIC PROBE 36DA
ADC 2 1FL2
CAPTAIN STATIC PROBE 35DA
FIRST OFFICER STATIC PROBE 37DA
STANDBY STATIC PROBE 39DA
STANDBY MANIFOLD AND DRAIN
CAPTAIN MANIFOLD AND DRAIN
FIRST OFFICER MANIFOLD AND DRAIN
PRESS SWITCH 8HU
FIRST OFFICER STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
CAPTAIN STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
STANDBY STATIC PRESSURE PICK-OFF FOR TRAILING CONE INSTALLATION
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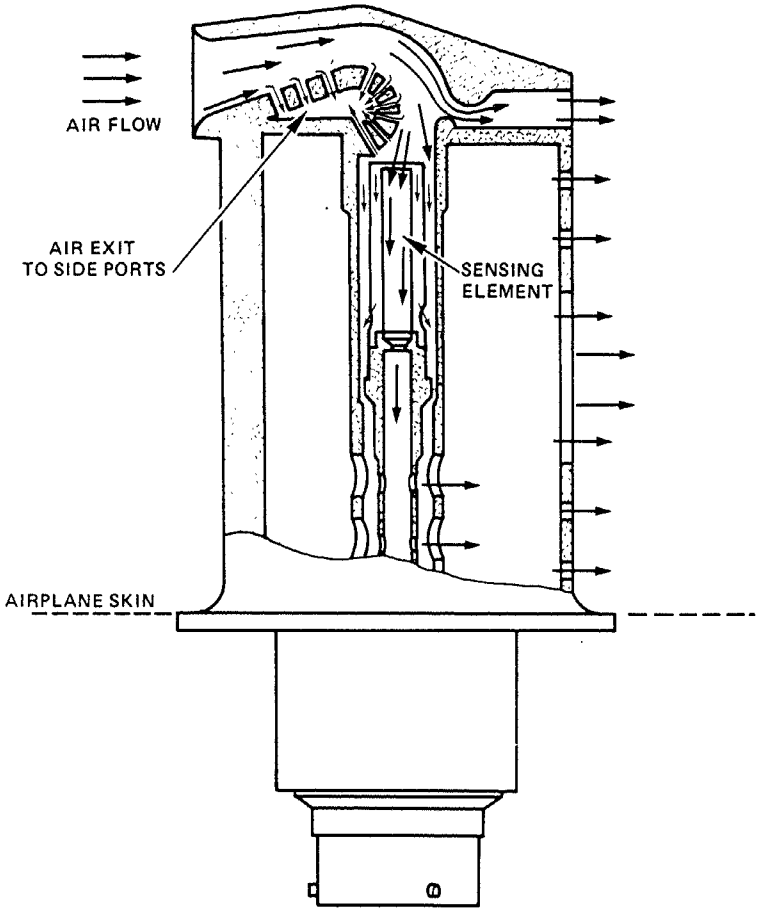
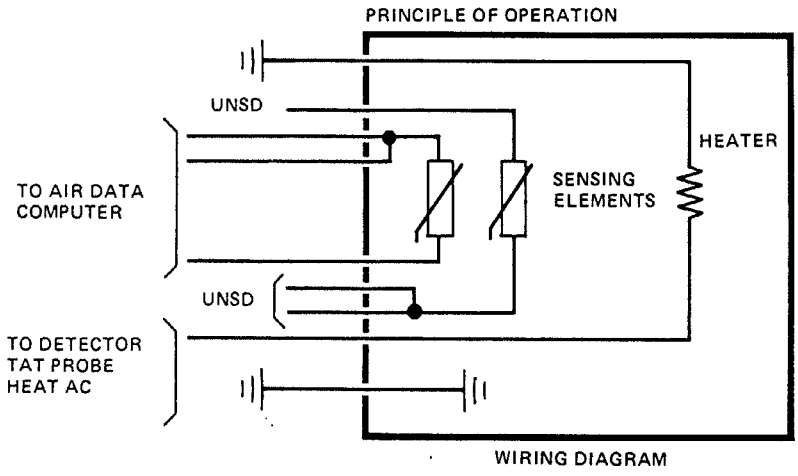
Pitot Static System
Figure 002

means of Flight Systems type NC - Series 40 000 self-sealing quick attach/disconnect (QAD) unions.
The pressure systems take account of minimum slopes recommended by ARP 920 document and are provided with drains located at a low point : three drains in the case of the static pressure systems, two drains in the case of the total pressure systems. The pitot probe system of the standby system needs no drain as the pitot is located at a low point of the system.
NOTE : Probe heating systems are described in chapter 30 (Ref. 30-31-00, P. Block 001).

4. Temperature Probes
(Ref. Fig. 003)
Two total air temperature probes are located at the lower part of the fuselage.
. These probes are heated with 115VAC.
. Each probe is connected to an ADC.
. Each probe includes a sensing element the nominal resistance of which is 500 Ohms at 0° Celsius. The resistance of this sensing element varies in relation to the total air temperature. The ADC computes the total air temperature by measuring this resistance.

NOTE : The probe heating system is discribed in chapter 30.





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DM5

Total Air Temperature Probe
Figure 003

5. ALPHA Probes

The aircraft is equipped with three ALPHA probes : two are located on the RH side, one on the LH side of the fuselage centerline.

A. Description and Operation

(Ref. Fig. 004)
(Ref. Fig. 005)

The ALPHA probe is of the weather vane type. Its sensing element features a small wing which is positioned in the direction of the airflow.
The small wing is mechanically linked to a shaft which drives the devices transmitting the local angle-of-attack signal. These transmitting devices are made up of synchro resolvers. The ratio between local angle-of-attack variations and resolver signal variations is 1 (1 resolver degree per local angle-of-attack degree).
The whole mechanism is stabilized around the rotation axis. In addition, a damper enables a satisfactory dynamic response to be obtained (filtering of airflow oscillations).

- Built-in test equipment comprising two solenoids enables the probe to be positioned at a local angle-of-attack of + 41°, taking account of its setting. The test controls are located on panel 470VU (Ref. 34-10-00, P. Block 1).
- The vane and the unit are heated with 115VAC. The heating system is self-regulated so as to maintain a temperature of the sensing elements sufficient for ice protection in flight and a temperature limited to a satisfactory value (about 120° C) during operation on the ground. Monitoring of wing heating is ensured.

NOTE : The probe heating system is described in chapter 30 (Ref. 30-31-00, P. Block 001).

B. Setting on Aircraft

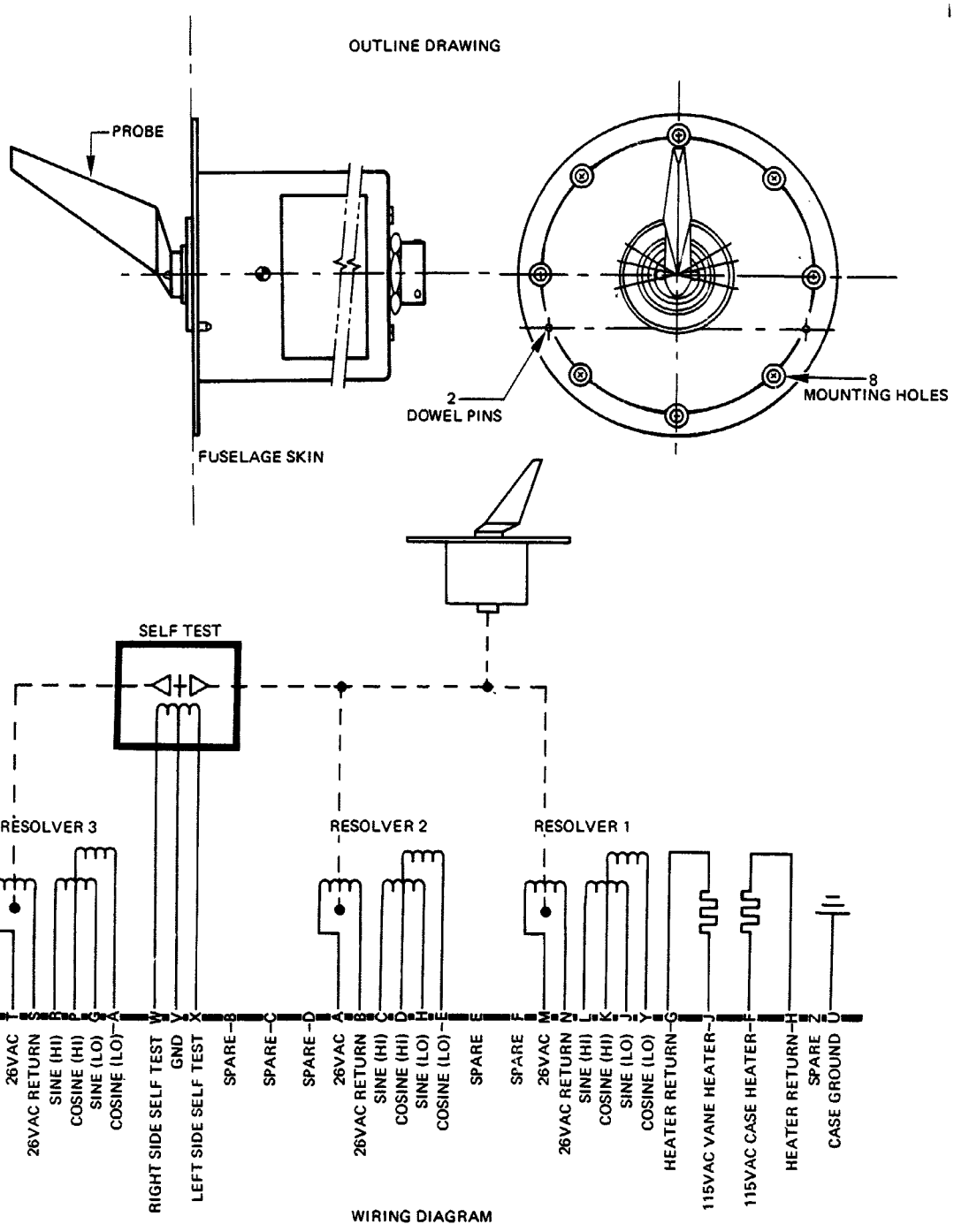
The ALPHA probe setting is at 25° below the fuselage horizontal reference line.
(Ref. Fig. 006)
The rotation angle of each probe around zero resolver is ± 60° (which corresponds to a local angle of attack of +25°).
The local angle-of-attack range covered by the rotation of each probe is thus -35° to 85°.

C. Electrical Outputs

These are made up of resolver signals (angle sine and cosine). The resolvers are excited by 26V 400 Hz from the aircraft electrical network.

Characteristics

Input voltage	:	26VAC 400 Hz
Output voltage	:	10.8VAC
Phase shift	:	8.8 to 24 degrees
Rotor impedance (Zro)	:	a + jb ; a < 315Ω, b < 725Ω
Stator impedance		



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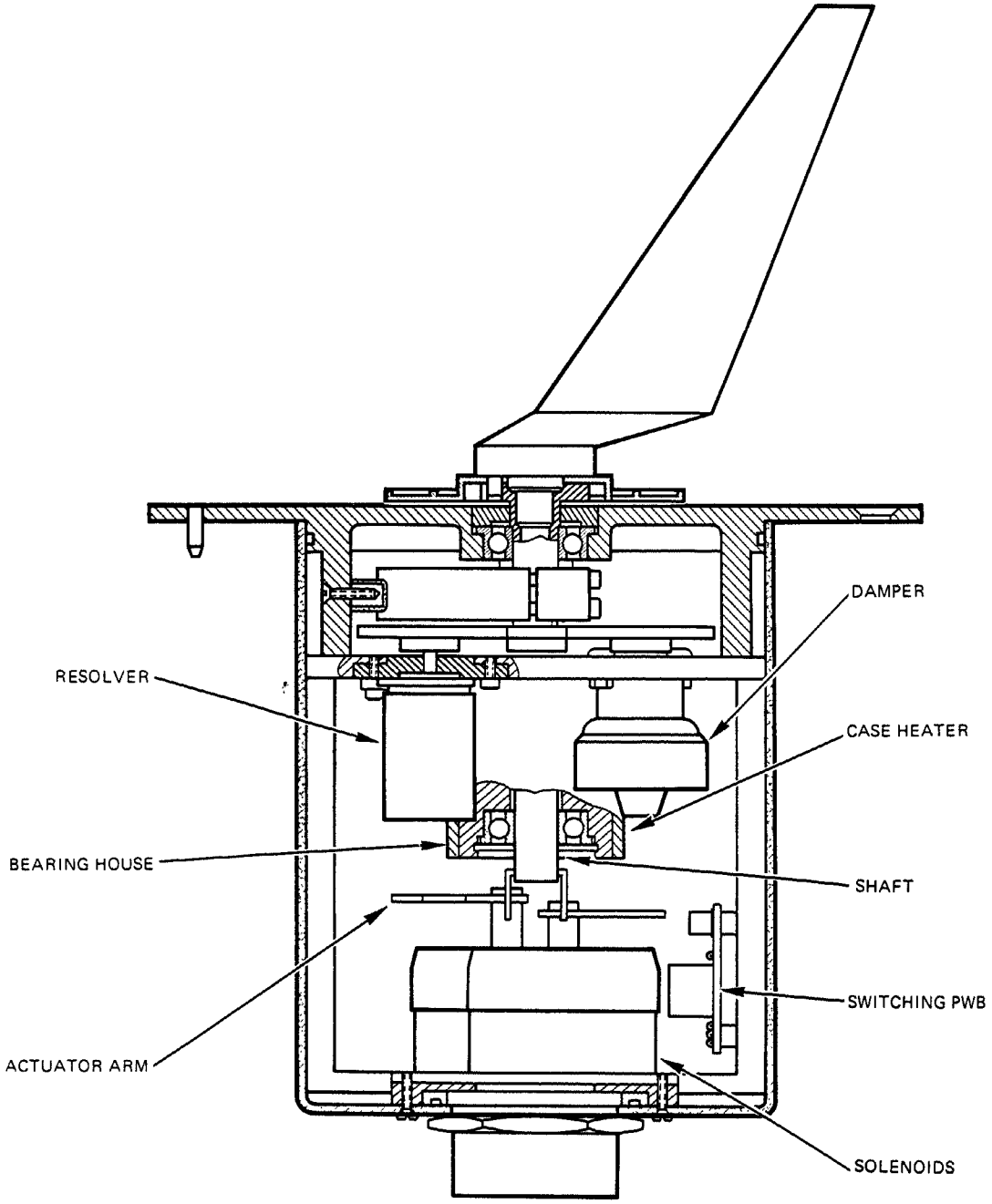
Alpha Probe - Outline and Wiring
Figure 004



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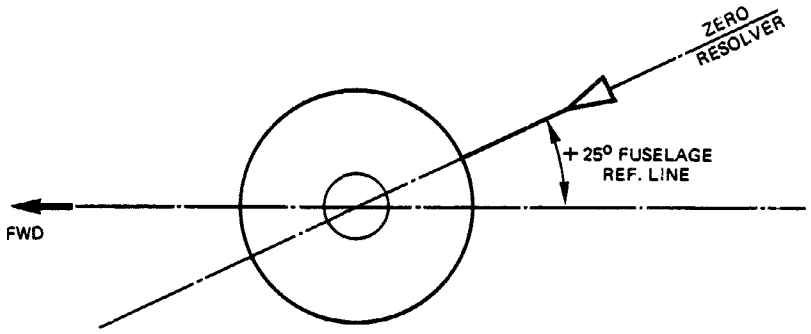
Alpha Probe - Cross Section Drawing
Figure 005



	$\frac{d\alpha l^{\circ}}{d\beta^{\circ}}$
PROBE 1	+0.23
PROBE 2	− 0.23
PROBE 3	− 0.26

BM5 34 11 00 0 CEUO

Alpha Probe Setting and Skid Effect
Figure 006

(Zso) : c + jd ; c < 45Ω, d < 165Ω

Range : ±60°

Scale factor : 1° resolver/1° local AOA.

6. Air Data Computers (ADCs)

A. Description and Operation

The ADC is a digital equipment, in compliance with ARINC Characteristic 706.

(1)Layout

Both ADCs are located in electronics racks 80VU and 90VU.

(Ref. Fig. 007)

ADC1, which is connected to the Captain's instruments, is located in electronics rack 90VU, shelf 96VU, in a special compartment fitted with a smoke detector as it remains automatically supplied during accomplishment of a SMOKE emergency procedure.

ADC2 is connected to the First Officer's instruments and it is located in electronics rack 80VU, shelf 86VU.

(2)ADC Inputs

R **ON A/C 001-100,

(Ref. Fig. 008)

R **ON A/C 101-200,

R (Ref. Fig. 009)

R **ON A/C ALL

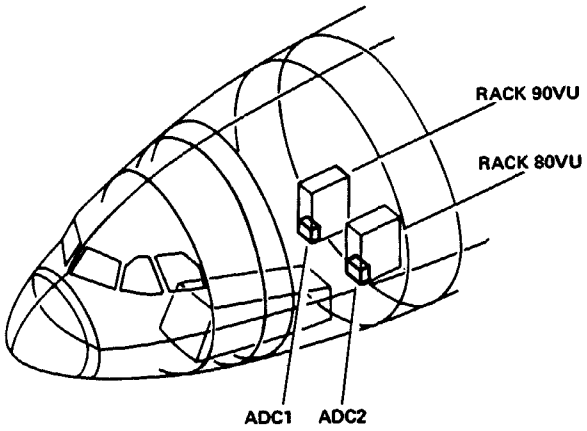
Static pressure and total pressure data is transmitted through pressure lines which are connected to the face of the ADC by means of self-sealing unions.

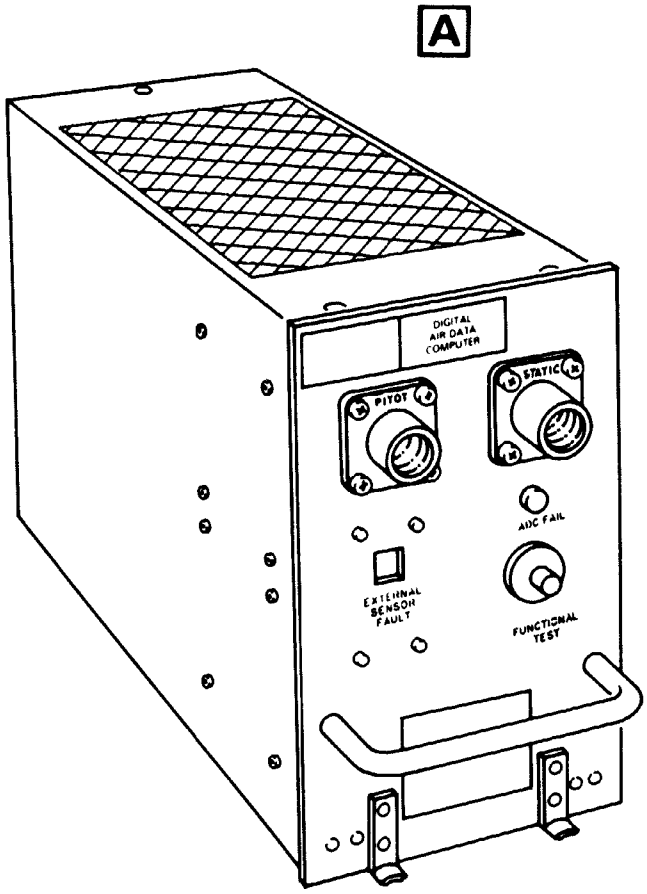
The input electrical data is the following

- total air temperature, which is transmitted by a total air temperature probe the sensing element of which is a variable resistance
- local angle-of-attack, which is transmitted by two resolvers located in an ALPHA probe of the weather vane type
- barometric correction : two barometric correction signals are transmitted to each ADC by two resolvers located in the Captain's and First Officer's altimeters
- discrete inputs : discrete signals are transmitted to the ADCs
  . to be encoded on ARINC 429 digital busses
  . or to determine a computation program adapted to the air data system installation on the aircraft.

On the aircraft, the following discrete inputs are used :

- functional test : enables a functional test to be activated
- angle-of-attack unique program : determines the utilization of the two local angle-of-attack resolver inputs. Input No. 1 is used for both local and corrected angle-of-attack.
  In case this input is not available, the ADC uses the other input.
- SSEC (Static Source Error Correction) selection discrete : this input enables a different correction law to be selected when the aircraft configuration changes, depending on flaps position.
- Barometric correction input discrete : indicates that the ADC must pro-





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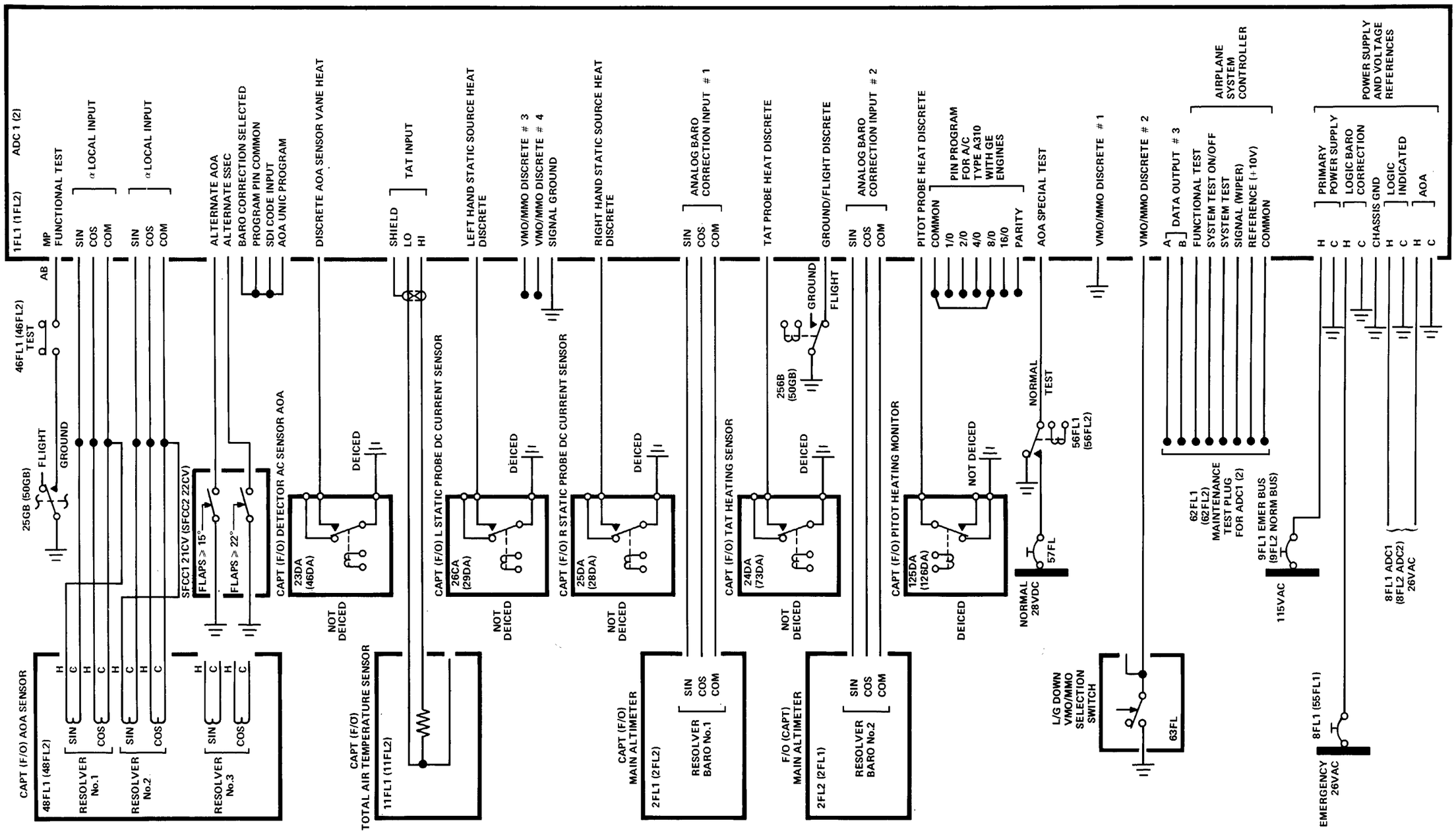
ADCs - Location
Figure 007



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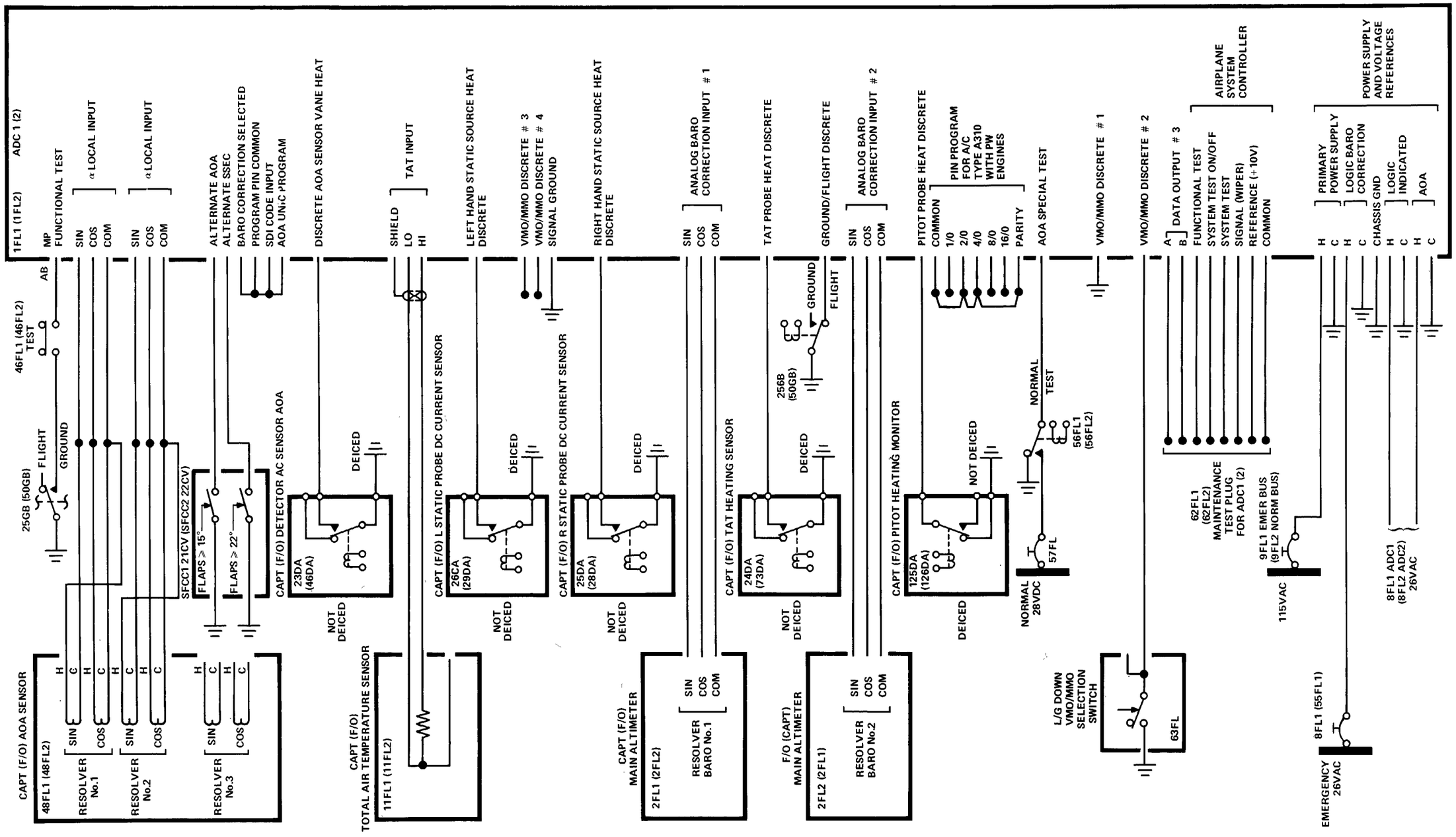
ADC1 (2) Inputs
Figure 008



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ADC1 (2) Inputs
Figure 009

R

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cess two different barometric correction inputs from the Captain's and First Officer's instruments.

- Aircraft code identification : code 06 being attributed to aircraft by ARINC, a connection between four particular input pins enables the equipment to determine whether a computation program using pressure correction laws, VMO/MMO laws, angle-of-attack correction laws adapted to aircraft and memorized, must be performed.
- Ground/Air discrete : this input, issued from the landing gear system, indicates to the equipment whether the aircraft is on the ground or in flight.
- Source identifier : two inputs enable the location of the equipment on the aircraft to be determined : either side No.1 (associated to the Captain's circuits) or side No.2 (associated to the First Officer's circuits).
  This indication is encoded for use by the concerned equipment, in compliance with ARINC Characteristic 429.
- ALPHA probe heating discrete : one input allows to determine whether the ALPHA probe heating is operative or inoperative.
- Pitot probe - static probe heating discretes : three inputs allow to determine whether the heating of the pitot probe and the fuselage two static probes associated with the ADC is operative or not.
- TAT probe heating discrete : one input allows to determine whether the total air temperature probe heating is operative or not.
  . ALPHA probe special test discrete : this input is used when, for ground maintenance requirements, the ALPHA probe associated with the ADC is mechanically positioned at a test value (as per system described in 34.18).
  In this case, the ADC repeats the received value and transmits to ARINC 429 busses the corresponding local angle of attack and the corrected angle of attack with a SSM : Functional Test.
  . External Controller Interface : on the ground, a test set can be connected to the ADC through a test connector located in electronics rack 90VU (for ADC1) or 80VU (for ADC2).
  This test set enables simulation of any flight configuration determined by altitude and speed.
  The required parameters are obtained by performing adjustments on the test set to read the values on ARINC 429 busses or on the instruments located on the instrument panels.

(3)ADC outputs

The outputs which are used on the aircraft are made up of four independent identical "Low Speed" digital busses in compliance with ARINC Specification 429

. Table 1 shows the computation range of the output parameters.
. Table 2 shows the resolution characteristics of the output parameters.
. Tables 3 and 4 show the codings of the various output parameters in the digital message.
. Table 5 shows the coding of the discrete words having labels 270 and 271.
. Tables 6 and 7 show the coding of maintenance words.
  These maintenance words, which have labels 350, 351, 352 determine the results of the various monitoring tests performed in the ADCs.

The word 353 enables a recall of the first two failures that occured in flight.

TABLE 1

	ALTITUDE		CAS		MACH		TAS		SAT		TAT	
	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI
ADC NORMAL OPERATING RANGE	-1000	+50,000	30	450	0.10	1.00	100	699	-99	+60	-60	+99
ADC ELECTRICAL STOPS	-2000	+51,000	0 (5)	600	0.00 (2)	1.10	0 (3)	650	-99	+80	-80	+99
CONTENTS OF DATA FIELD WHEN ELECTRICAL STOPS ARE EXCEEDED	-2000	+51,000	0	500	0.00	1.10	0	650	-99 (1)	+60	-80 (1)	+99
SSM STATE WHEN ELECTRICAL STOPS ARE EXCEEDED	NCD	NCD	NCD	NCD	NCD	NCD	NCD	NCD	NCD	NCD	NCD	NCD
DISPLAY INDICATOR RESPONSE TO NCD CONDITION	FAILURE WARNING		DISPLAY CONTENTS OF DATA FIELD		DISPLAY CONTENTS OF DATA FIELD		DISPLAY CONTENTS OF DATA FIELD		FAILURE WARNING		FAILURE WARNING	

(1) THE DATA FIELD OF THE BINARY WORD WILL INDICATE -99 ; THE DATA FIELD OF THE BCD WORD WILL INDICATE +99

(2) FOR MACH < 0.10, THE MACH DATA FIELD INDICATES 0.0 MACH AND SSM STATE IS NCD

(3) FOR TAS < 100 KTS, THE TAS DATA FIELD INDICATES 0 KNOTS AND SMM STATE IS NCD

(4) THE DATA FIELD OF THE BINARY WORD WILL INDICATE -80 ; THE DATA FIELD OF THE BCD WORD WILL INDICATE +80

(5) FOR CAS < 30 KNOTS : CAS DATA FIELD = 0.0 KNOTS, SSM = NCD

TABLE 2

Function	Equipment Specification Requirement	ADC Computed Resolution
Pressure Altitude	1.0 ft.	0.2 ft.
Baro Corrected Altitude	1.0 ft.	0.2 ft.
Baro Correction	1.0 ft. at 1013.25mb and 29.92 in. Hg.	0.77 ft. at 1013.25mb and 29.92 in. Hg.
Altitude Rate	.847mb/mn or 30 ft/mn	10.4 ft/mn
Computer Airspeed	0.0625 kt for CAS>100 kts	0.10 kt 0.048 kt above 100 kts
Mach	0.0000625 for M>.2M	0.0001 Mach at.1 Mach decreasing to .00006 Mach at .2 Mach for TAS> 100 kts 0.00006 Mach above .2 Mach
True Airspeed	0.0625 (BNR);1.0 kt (BCD)	.05 kt
Static Air Temperature	0.25°C (BNR); 1.0°C (BCD)	.04°C
Total Air Temperature	0.25°C (BNR); 1.0°C (BCD)	.04°C
Impact Pressure	0.03125mb	0.021mb
Total Pressure	0.07125mb	0.02mb
Indicated Angle-of-Attack	0.05°	.046°
Corrected Angle-of-Attack	0.05°	.046°
Maximum Operating Airspeed	0.25 kt	.25 kt
Static Pressure	N/A	.03 in. Hg at 1 in. Hg linearly increasing to .25 at 32 in. Hg

TABLE 3

DIGITAL BUS OUTPUTS

Data Bus	Bus Format	Bit Rate	Connector (A)	Pin Numbers (B)
Data Bus # 1	429	Lo	MP 2A	MP 2B
Data Bus # 2	429	Lo	MP 4A	MP 4B
Data Bus # 3	429	Lo	MP 6A	MP 6B
Data Bus # 4	429	Lo	MP 8A	MP 8B

TABLE 4

DIGITAL BUS OUTPUT WORDS

Signal	Octal Label	Signal Format	Digital Range	Approximate Resolution	Units	Update Rate (Hz)
ADC Discretes #1	270	DIS	N/A	N/A	N/A	2
ADC Discretes #2	271	DIS	N/A	N/A	N/A	2
Altitude (29.92)	203	BNR	±131.072	1	Feet	16
Altitude (Baro #1)	204	BNR	|	|	|	16
Altitude (Baro #2)	220	BNR	±131,072	1	Feet	16
Altitude Rate	212	BNR	±32,768	16	Ft/mn	16
Baro Cor No.1 (In. Hg.)	235	BCD	±99.999	.001	In. Hg.	8
Baro Cor No.1 (MB)	234	BCD	±9999.9	.1	MB	8
Baro Cor No.2 (In. Hg.)	237	BCD	±99.999	.001	In. Hg.	8
Baro Cor No.2 (MB)	236	BCD	±9999.9	.1	MB	8
Computed Airspeed	206	BNR	±1024	.0625	Knots	8
Corrected AOA	241	BNR	±90	.05	Deg.	16
Impact Pressure	215	BNR	±512	.03125	MB	8
Indicated AOA	221	BNR	±90	.05	Deg.	16
MACH	205	BNR	±4096	6.25E-5	MACH	8
Maintenance Wd 1	350	DIS	N/A	N/A	N/A	2
Maintenance Wd 2	351	DIS	N/A	N/A	N/A	2
Max OPRTG Schedule	207	BNR	±1024	.25	Knots	8
Static Air Temp	213	BNR	±512	.0625	Deg. C	2
Static Air Temp-D	233	BCD	±99	1	Deg. C	2
Total Air Temp	211	BNR	±512	.0625	Deg. C	2
Total Air Temp-D	231	BCD	±99	1	Deg. C	2
Total Pressure	242	BNR	±2048	.03125	MB	8
True Airspeed	210	BNR	±2048	.0625	Knots	8
True Airspeed-D	230	BCD	±999	1	Knots	2
Maintenance Wd 3	352	DIS	N/A	N/A	N/A	2
Maintenance Wd 4	353	DIS	N/A	N/A	N/A	2
Static Pressure	217	BNR	±3.9998	.00006	in. Hg.	8

R01 TABLE 5

OUTPUT DISCRETE WORDS

Signal	FUNCTION 1	FUNCTION 0	Octal Label	BIT
Icing Detector On	ON	OFF	270	11
Pitot Heat On	ON	OFF	270	12
ADC Invalid	FAIL	GOOD	270	13
Pitot/Stat Heat On	ON	OFF	270	14
Static Heat On	ON	OFF	270	15
TAT Probe Heat On	ON	OFF	270	16
AOA No. 1 Heat On	ON	OFF	270	17
AOA No. 2 Heat On	ON	OFF	270	18
Overspeed	WARN	NO WARN	270	19
Onside AOA Fail	FAIL	GOOD	270	20
AOA Average	YES	NO	270	21
VMO Alternate #1	YES	NO	270	22
VMO Alternate #2	YES	NO	270	23
VMO Alternate #3	YES	NO	270	24
VMO Alternate #4	YES	NO	270	25
SSEC Alternate	YES	NO	270	26
AOAC Alternate	YES	NO	270	27
Baro Port "B"	YES	NO	270	28
Zero SSEC (MACH)	YES	NO	270	29
Dual Baro Discrete	DUAL	SINGLE	271	19
Zero SSEC (AOA)	YES	NO	271	11
AOA Special Test	YES	NO	271	12
ASC Bit Initiate	YES	NO	271	16
ASC On/Off	ON	OFF	271	17
ASC Hp/Vc	Hp	Vc	271	18

TABLE 6
ADC MAINTENANCE WORDS

ADC MAINTENANCE WORD NO. 1 LABEL 350

BIT	9	SDI	BIT 19	BIT Test 9
	10	SDI	20	BIT Test 10
	11	BIT Test 1	21	BIT Test 11
	12	BIT Test 2	22	BIT Test 12
	13	Spare	23	BIT Test 13
	14	Spare	24	BIT Test 14
	15	BIT Test 5	25	BIT Test 15
	16	BIT Test 6	26	BIT Test 16
	17	BIT Test 7	27	BIT Test 17
	18	Spare	28	BIT Test 18
			29	BIT Test 19

ADC MAINTENANCE WORD NO. 2 LABEL 351

BIT 9	SDI	BIT 19	BIT Test 28
10	SDI	20	BIT Test 29
11	BIT Test 20	21	BIT Test 30
12	BIT Test 21	22	BIT Test 31
13	BIT Test 22	23	BIT Test 32
14	BIT Test 23	24	BIT Test 33
15	BIT Test 24	25	Spare
16	BIT Test 25	26	Spare
17	BIT Test 26	27	Spare
18	BIT Test 27	28	Spare
		29	Spare

TABLE 7
ADC MAINTENANCE WORDS

ADC MAINTENANCE WORD NO. 3

BIT 9	SDI	BIT 21	PS Probe Memory Checksum
10	SDI	22	PT Probe Memory Checksum
11	Checksum Chip 1	23	Aircraft correction memory checksums
12	Checksum Chip 2	24	Aircraft type LSB
13	Checksum Chip 3	25	Aircraft type LSB+1
14	Checksum Chip 4	26	Aircraft type LSB+2
15	Checksum Chip 5	27	Aircraft type LSB+3
16	Checksum Chip 6	28	Aircraft type MSB
17	Checksum Chip 7	29	Aircraft type parity
18	Checksum Chip 8		
19	Checksum Chip 9		
20	Checksum Chip 10		

ADC MAINTENANCE WORD NO. 4

BIT 9 -|		BIT 25 -|	
10 |		26 |	
11 |		27 |-	Flight No.
12 |		28 |	
13 |-	Fault No.	29 -|	
14 |		30	0
15 |		31	0
16 -|			
17 -|			
18 |			
19 |			
20 |			
21 |-	Fault No.		
22 |			
23 |			
24 -|			

(4)ADC Technology
(a)The ADC utilizes a 16-bit Z8002 microprocessor which controls all the computations to be performed following a programm stored in ROMs
(Ref. Fig. 010)
- Acquisition of input data : pressure, temperature, local angle-of-attack, baro correction, discrete inputs
- computation of air data parameters
- elaboration of ARINC 429 digital messages.
- monitoring tests.

(Ref. Fig. 011)
The ADC is contained in an ARINC 600 4MCU case. It is made up of the following components :
- two pressure probe circuits
- two electronic cards for acquisition and conversion of input signals
- one computation card including the microprocessor and the associated RAMs and ROMs
- one ARINC interface card for the elaboration and the transmission of the ARINC 429 message and eventually, the reception of ARINC 429 baro correction digital messages (this facility is not utilized on the aircraft).
- a system of stabilized power supply.

(5)Principle of Operation
(a)Pressure Measurement
The static and total pressures provided by the aircraft pressure systems are measured by means of two absolute pressure transducers provided with vibrating diaphragms
(Ref. Fig. 012)
The diaphragm exposed to a differential pressure equal to the pressure to be measured is excited by a coil/magnet assembly.
The coil delivers an oscillating field produced by an oscillating electronic circuit the frequency of which is automatically tuned to the mechanical resonance frequency of the diaphragm.
The resonant frequency of the diaphragm is a known function of the pressure to which it is exposed. So the pressure can be measured by measuring the resonant frequency of the diaphragm.
The frequency output from each transducer is calibrated during production cycle, by measuring the frequencies for various pressures and temperatures.
The various coefficients defining the law :
pressure = function (frequency, temperature)
are memorized on an electronic card integral with the transducer, which thus constitutes an interchangeable device (Ref. Fig. 013)
The computer uses these coefficients memorized in the transducer assemblies to determine the ADC static and total input pressures.
A very accurate time counter is used for measuring a duration of 32 periods in the case of the static pressure transducer, and 16 periods in the case of the total pressure transducer.

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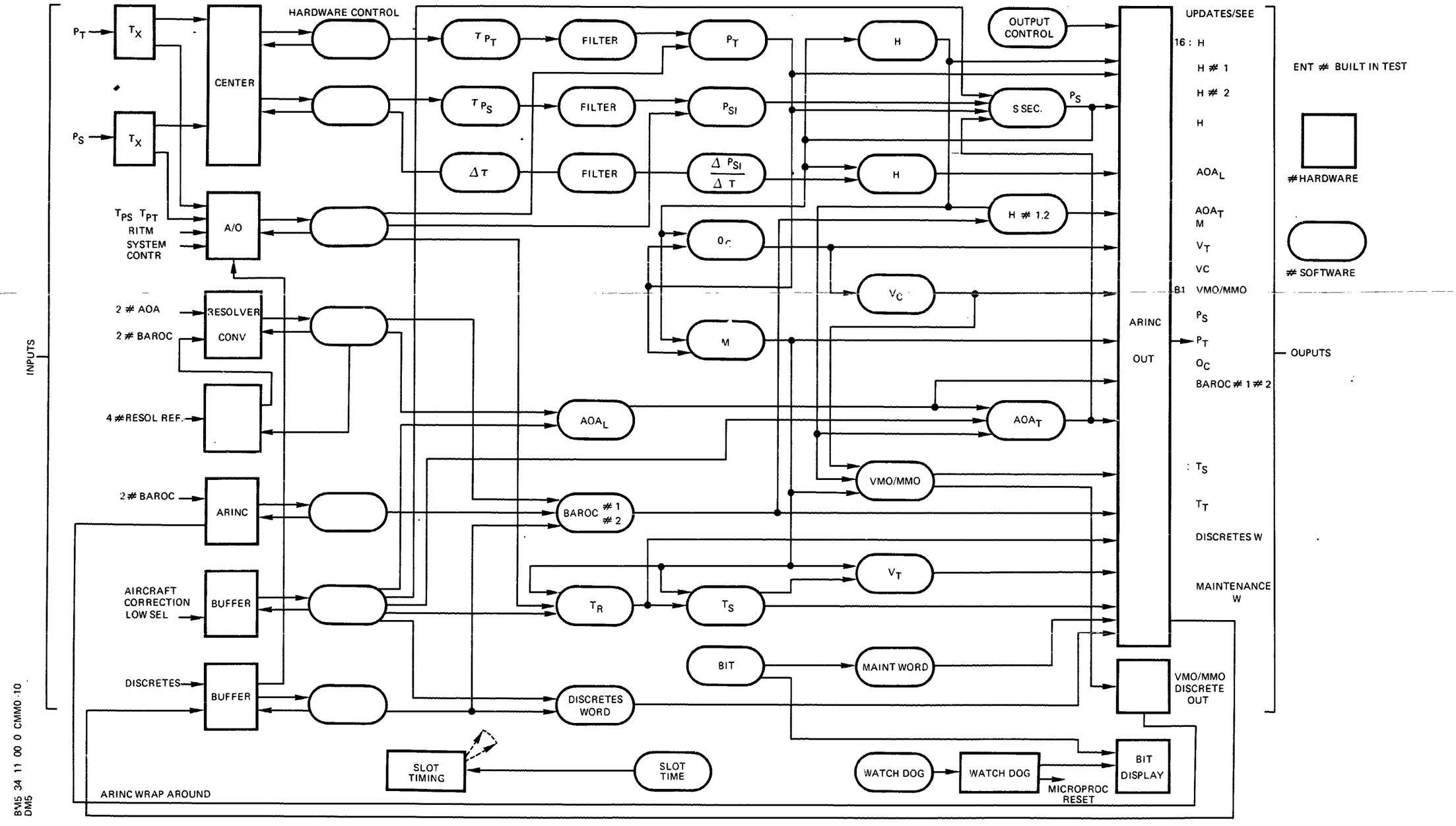
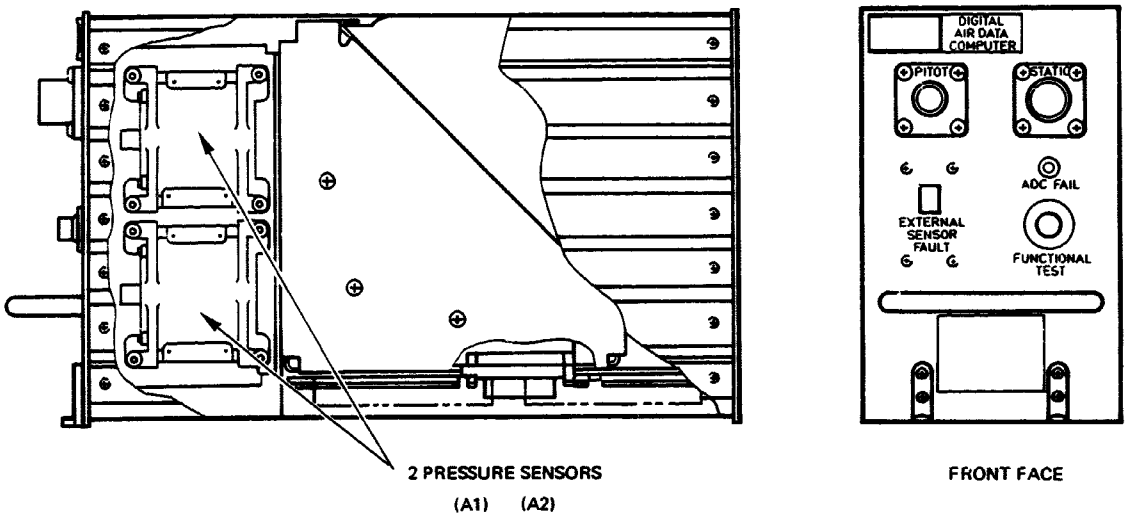
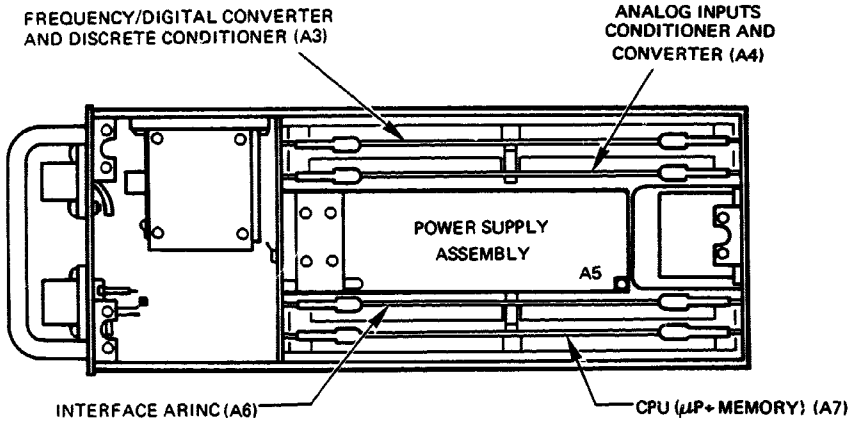


ADC Functional Block Diagram
Figure 010





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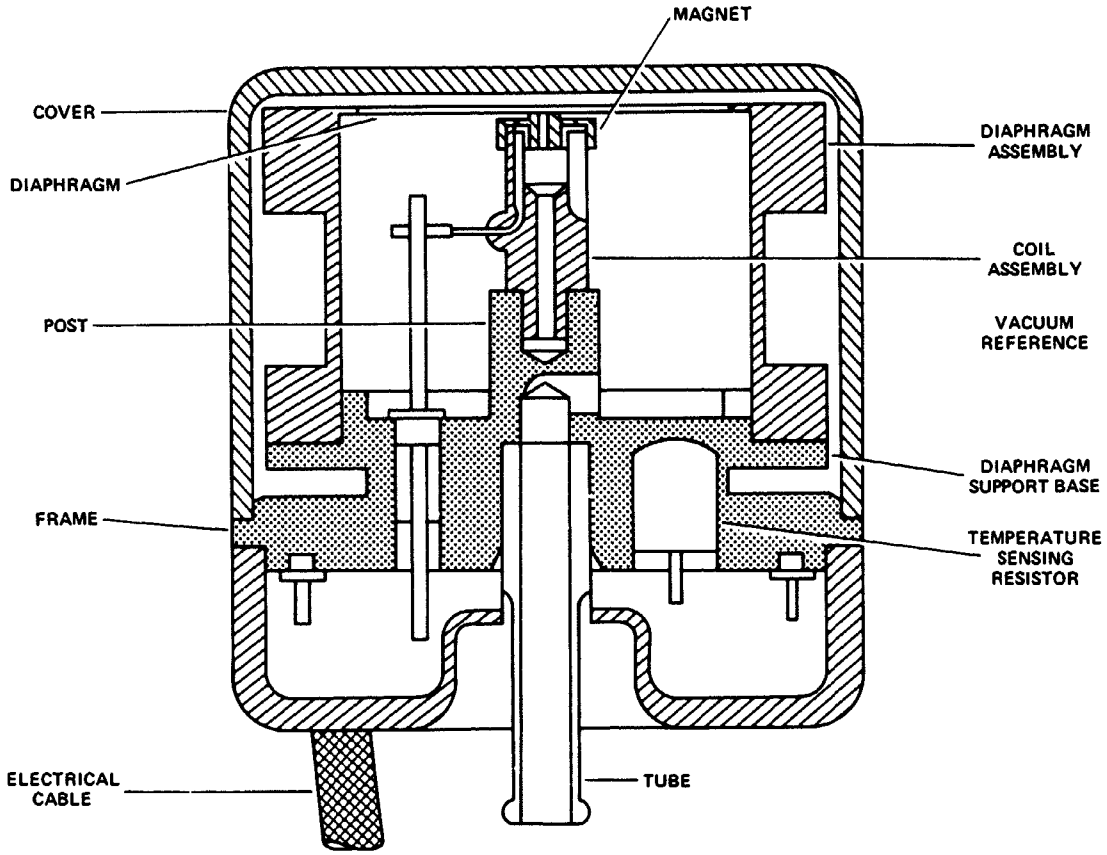
ADC Layout
Figure 011



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WITH NO MECHANICAL OR ELECTRICAL CONNECTION BETWEEN THE DIAPHRAGM AND THE OSCILLATOR CIRCUITRY, THE OUTPUT IS STABLE, HAS HIGH-Q AND EXTREMELY LOW HYSTERESIS

Vibrating Diaphragm Pressure Transducer
Figure 012

(b)Pressure Computation

The ADC computes the pressures in relation to the measured frequencies by means of a polynomial to the power 6 in frequency, and to the power 3 in temperature.

The coefficients of these various polymonials, which are specific to each transducer, are memorized on an electronic card located on the transducer.

(Ref. Fig. 013)

(c)Flight Parameter Computation

The ADC computes the following parameters :

- corrected angle-of-attack, using local angle-of-attack converted from analog to digital format

Basic Law : (Flaps < 15°)
ALPHA i ≤ 20.13°, ALPHA c = $\frac{\text{ALPHA i}}{1,83}$ + 1°
ALPHA i > 20.13°, ALPHA c = $\frac{\text{ALPHA i}}{1,65}$ - 0,2°
Alternate Law : (MP8F Grounded/Flaps ≥ 15°)
ALPHA i ≤ 26°, ALPHA c = $\frac{\text{ALPHA i}}{1,67}$ - 0,57°
ALPHA i > 26°, ALPHA c = $\frac{\text{ALPHA i}}{1,49}$ - 2,45°

For an airspeed below 75 Kts, ALPHA C = 0

- static pressure correction, in relation to Mach number indicated and true angle-of-attack, using the coefficients specific to the aircraft and memorized in the ADC.

  The correction laws used are of the form :

  $\frac{Ps - Psi}{Ps}$ = G1 (Mi) + G2 (Mi, alpha c),

  where Ps : atmospheric static pressure,

  Psi, MI : Static pressure and indicated Mach number.

G1 and G2 coefficients are memorized for various Mach numbers indicated and various corrected angle-of-attack values. In the case of intermediate values of Mach and corrected angle-of-attack, the computer performs an interpolation between the points of G1 (Mi) and G2 (Mi, alpha c) coefficient correction table.

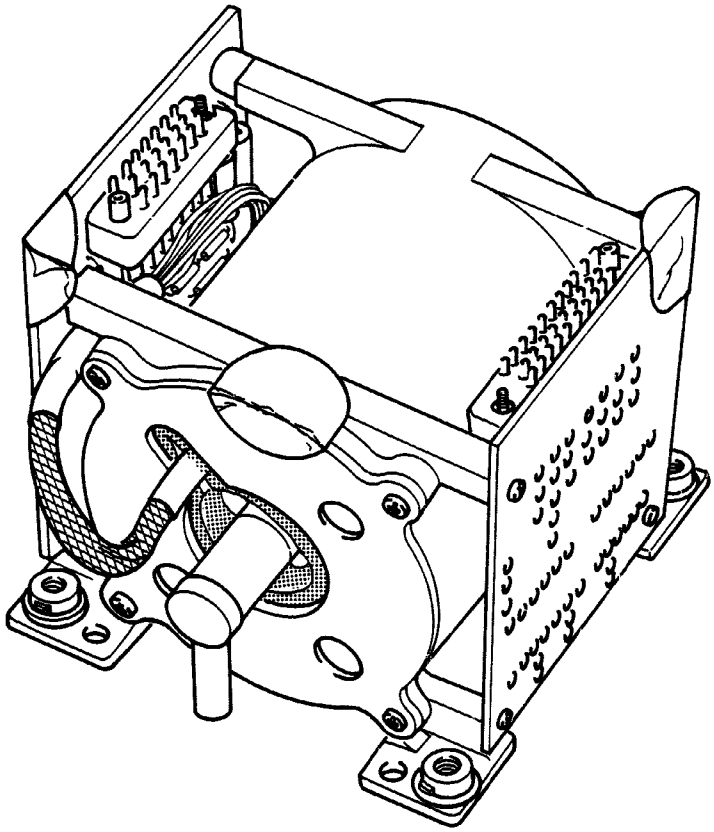
- Primary air data parameters

  Standard altitude, vertical speed, computed airspeed and Mach number are computed from corrected Pt and Ps, by applying a polynomial method of calculation to aerodynamic equations.

- All parameters derived from the preceding ones.

  The baro corrected altitudes are computed from the standard altitude and the baro correction signals transmitted to the ADC by the altimeters. These resolver-type signals are converted to digital format at the ADC input, so as to be used in the computation program.

- The total temperature is computed from the measured value of the



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Pressure Transducer Module
Figure 013

temperature probe sensitive resistance and the applicable corrections due to de-icing and self-heating.
These corrections are dependent on Mach number.

- The static temperature and the true airspeed are computed from the total temperature and Mach number.
- **VMO/MMO** value and overspeed warning are derived from the **VMO/MMO** law memorized in the **ADC**.

B. Monitoring

The ADC includes a monitoring circuit for the detection of failures in any of its components.

The monitoring principle consists in performing various tests so as to make sure that all the ADC components operate correctly, that the input data is credible and that the computation and test program runs correctly.

This is done permanently during the computation cycle defined by the program, by means of a software.

The following tests can be performed :

- test of stabilized power supply
- tests concerning analog data inputs : check of input resolvers, baro-correction resolvers and total air temperature probe.
- tests of programming discrete inputs, or inputs of data to be encoded
- tests of input circuits : operational check of the analog/digital and frequency/digital converters
- tests of the components directly used by the computation program :
  . microprocessor
  . RAM, ROM and EAROM.

These tests are performed by :

. solving the sample problems the results of which are compared to memorized values
. computation of ROM sums (calibration memories and main memories)
. check of computation program execution (watch dog technique)
. ARINC output algebraic sum test
. ARINC output end around test and comparison with initial digital data.

On tables 1 and 2 are listed :

. the various tests performed (table 1)
. the consequences of test results on the status of the various output parameters.

TABLE 1

1. Left AOA Input Failure
2. Right AOA Input Failure
3. Spare
4. Spare
5. Total Air Temperature Input Failure
6. No. 1 Baro-Correction Input Failure
7. No. 2 Baro-Correction Input Failure
8. Spare
9. Aircraft Type Program Failure, Selected Aircraft Does Not Exist
10. ACM Memory Checksum
11. Overspeed Discrete End Around
12. A/D Calibration Voltage Failure
13. Sample Problem
14. Cache Memory Test
15. Main Memory Checksum
16. PS Probe Period Out of Limits
17. PS Probe Temperature Out of Limits
18. PS Probe Calibration Memory Checksum & Sensor Adjust Voltage Monitor
19. F/D Conversion Incomplete
20. PT Probe Period Out of Limits
21. PT Probe Temperature Out of Limits
22. PT Probe Calibration Memory Checksum & Sensor Adjust Voltage Monitor
23. ARINC Output Algebraic Sum Test
24. ARINC Output End Around Test - Stop Transmission
25. ARINC Transmissions Incomplete
26. Power Supply Test
27. Angle-of-Attack Comparison (No ADC Fail)
28. PS=PT (Functional Test Only)
29. AOA Average Fail
30. PS Probe Temperature = PT Probe Temperature
31. Program Sequence Monitor
32. Alternate VMO Discretes
33. EAROM Write/Read Test
34. Spare
35. Spare
36. Spare

TABLE 2

TEST No.	1	2	5	6	7	9	10	11	12	13,14,15,26	16,17,18	19,30	20,21,22	23,25	24,31	27,29	28
ALTITUDE (29.921)						X	X		X	X	X	X	X			X	X
ALTITUDE (BARO 1)				X		X	X		X	X	X	X	X			X	X
ALTITUDE (BARO 2)					X	X	X		X	X	X	X	X			X	X
ALTITUDE RATE						X	X		X	X	X	X	X		S T O P	X	X
BARO COR NO. 1				X					X	X							

TEST No.	1	2	5	6	7	9	10	11	12	13,14 15,26	16,17 18	19 30	20,21 22	23 25	24 31	27 29	28
BARO COR No. 2					X				X	X							
COMPUTED AIRSPEED						X	X		X	X	X	X	X		R	X	X
CORRECTED AOA	X	X				X	X		X	X					I	X	
IMPACT PRESSURE						X	X		X	X	X	X	X		N		X	X
INDICATED AOA	X	X							X	X		X			C	X	X
MACH						X	X		X	X	X	X	X		T	X	X
MAX OP'R'TG SCHEDULE						X	X		X	X	X	X	X		R	X	X
OVERSPEED WARNING (*)						X	X	X	X	X	X	X	X		A	X	X
STATIC AIR TEMP			X			X	X		X	X	X	X	X		N	X	X
TOTAL AIR TEMP			X			X	X		X	X	X	X	X		S	X	X
TOTAL PRESSURE									X	X		X	X		M	X	X
TRUE AIRSPEED			X			X	X		X	X	X	X	X		I	X	X
ADC FAIL							X	X	X	X	X	X	X	X	S		X
															I		
															O		
															N		
															S		
															S		
															I		
															S		
															I		
															O		
															N		

(*) : Fail overspeed by deactivating the overspeed warning

C. Distribution of ADC Outputs
(1)ADC1 digital outputs distribution
(a)Output bus 1 provides digital data to :
- Captain's altimeter (normal operation)

**ON A/C 001-003,

- Captain's vertical speed indicator (normal operation)

R **ON A/C 004-200,

- Captain's VSI/TCAS indicator (normal operation)

R **ON A/C 101-200,

- FADEC 1

**ON A/C ALL

(b)Output bus 2 provides digital data to :
- EFIS SGU1, SGU2 and SGU3
  They generate corresponding symbols which are displayed on ND1, PFD1, PFD2 and ND2.
- First Officer's altimeter (if ADC2 failed, this instrument displays ADC1 data).

**ON A/C 001-003,

- First Officer's vertical speed indicator (if ADC2 failed, this instrument displays ADC1 data).

R **ON A/C 004-200,

- First Officer's VSI/TCAS indicator (if ADC2 failed, this instrument displays ADC1 data).

**ON A/C ALL

(c)Output bus 3 provide digital data to :
- ATC1
- ECAM SGU1 and SGU2
  They generate corresponding symbols which are displayed on right and left Ecam Display Unit.
- FCC1
- SFCC1 and SFCC2
- TCC1
- TCC2 (if installed)

R **ON A/C 001-100,

- PMC1

R **ON A/C 101-200,

- FADEC 2

R **ON A/C ALL

- AIDS (if installed)

- CGCC
- TRP

(d)Output bus 4 provides digital data to :

- ATC2
- EFCU1 and AFCU2
- FAC1 and FAC2
- FLC1 and FLC2
- FMC1 and FMC2
- FWC1
- GPWC
- IRS1, IRS2 and IRS3.

(2)ADC2 digital outputs distribution

(a)Output bus 1 provides digital data to :

- First Officer's altimeter (normal operation)

**ON A/C 001-003,

- First Officer's vertical speed indicator (normal operation)

R **ON A/C 004-200,

- First Officer's VSI/TCAS indicator (normal operation)

R **ON A/C 101-200,

- FADEC 1

**ON A/C ALL

(b)Output bus 2 provides digital data to :

- EFIS SGU1, SGU2 and SGU3
  They generate corresponding symbols which are displayed on ND1, PFD1, PFD2 and ND2.
- Captain's altimeter (if ADC1 failed, this instrument displays ADC2 data).

**ON A/C 001-003,

- Captain's vertical speed indicator (if ADC1 failed, this instrument displays ADC2 data).

R **ON A/C 004-200,

- Captain's VSI/TCAS indicator (if ADC1 failed, this instrument displays ADC2 data).

**ON A/C ALL

(c)Output bus 3 provide digital data to :
- ATC2
- FCC2
- SFCC1 and SFCC2
- ECAM SGU1 and SGU2
  They generate corresponding symbols which are displayed on light and left ECAM Display Unit.
- TCC1
- TCC2 (if installed)

R **ON A/C 001-100,

- PMC2

R **ON A/C 101-200,

- FADEC 2

R **ON A/C ALL

- AIDS (if installed)
- CGCC
- TRP

(d)Output bus 4 provide digital data to :
- ATC1
- EFCU1 and AFCU2
- FAC1 and FAC2
- FLC1 and FLC2
- FMC1 and FMC2
- FWC2
- IRS1, IRS2 and IRS3.

7. Power Supply

A. Distribution of ADC Component Power Supply
(Ref. Fig. 014)

B. Power Supply Failures
In the event of failure of the electrical power supply or in the case of smoke from an electrical source, load is shed from certain busses and some equipment is no longer supplied.
In electrical ultimate emergency configuration, the Captain's circuit (ADC and instruments except Navigation Display, and associated pitot probe)

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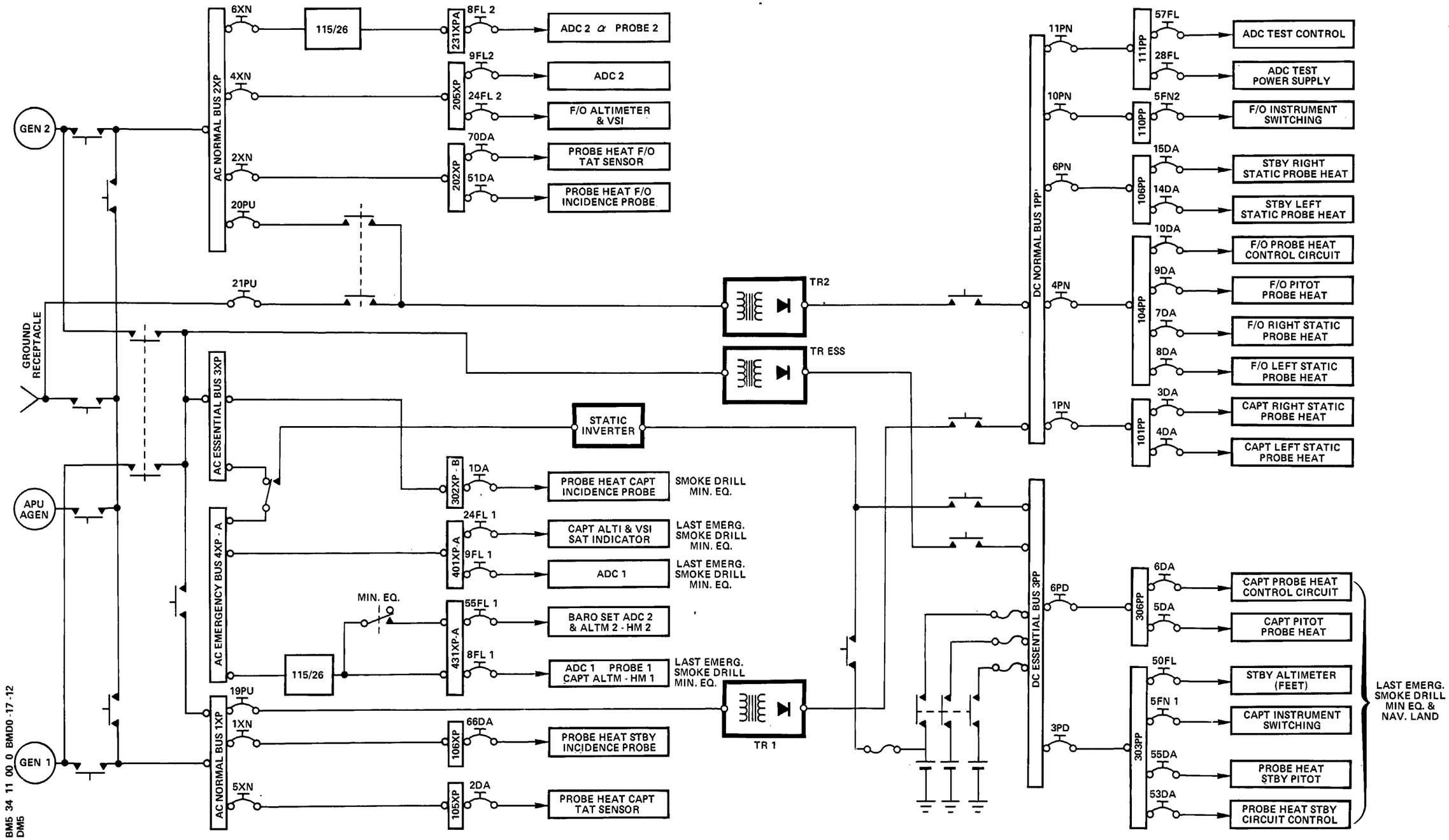


Air Data System - Power Supply Diagram
Figure 014

is supplied. The standby instruments are still supplied, but the standby pitot probe is not de-iced.
In smoke emergency configuration, the Captain's circuit (ADC, instruments ALPHA probe and pitot probe) and the standby instruments, and pitot probe are also supplied.

PITOT PROBE 40DA, 41DA, 42DA - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform, 3.00 m (10 ft.)
B.	Circuit Breaker Safety Clips
C.	Blanking Plugs/Caps
D.	O-Ring
E.	Gasket
Referenced Procedures	
- 34-10-00, P. Block 501	Flight Environment Data
- 20-23-12, P. Block 1	Specified Torque Values for Unions
- 24-41-00, P. Block 301	AC External Power Control
- 34-11-15, P. Block 601	Pitot Probes (40DA, 41DA and 42DA)

(Ref. Fig. 401)

2. Procedure

R WARNING : MAKE SURE THAT THE CIRCUIT BREAKER(S) RELATED TO THE WEATHER
R RADAR IS (ARE) OPENED, SAFETIED AND TAGGED.

CAUTION : PITOT PROBES ARE DELICATE INSTRUMENTS AND ARE CRITICALLY ALIGNED ON THE AIRCRAFT. EXTREME CARE MUST BE EXERCISED WHEN INSTALLING, REMOVING OR HANDLING. THEY MUST NOT BE DROPPED, SCRATCHED OR BENT.

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For Capt pitot probe 41DA

PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/CAPT/PITOT/SUPPLY	5DA	207/C24

(b)For F/O pitot probe 40DA

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES/F/O/PITOT	9DA	322/N67

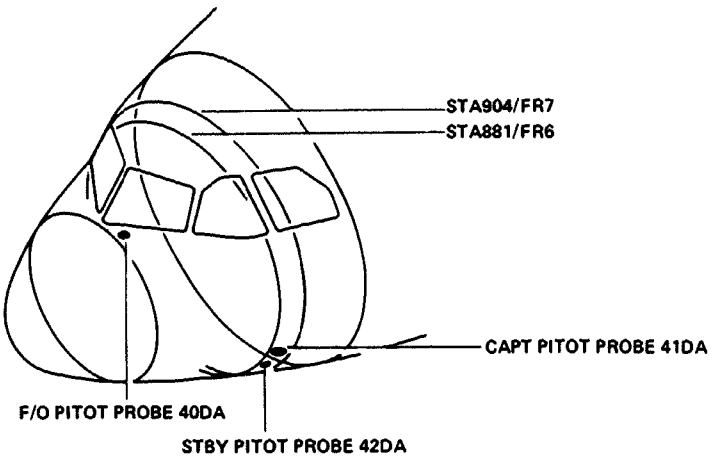
(c)For standby pitot probe 42DA

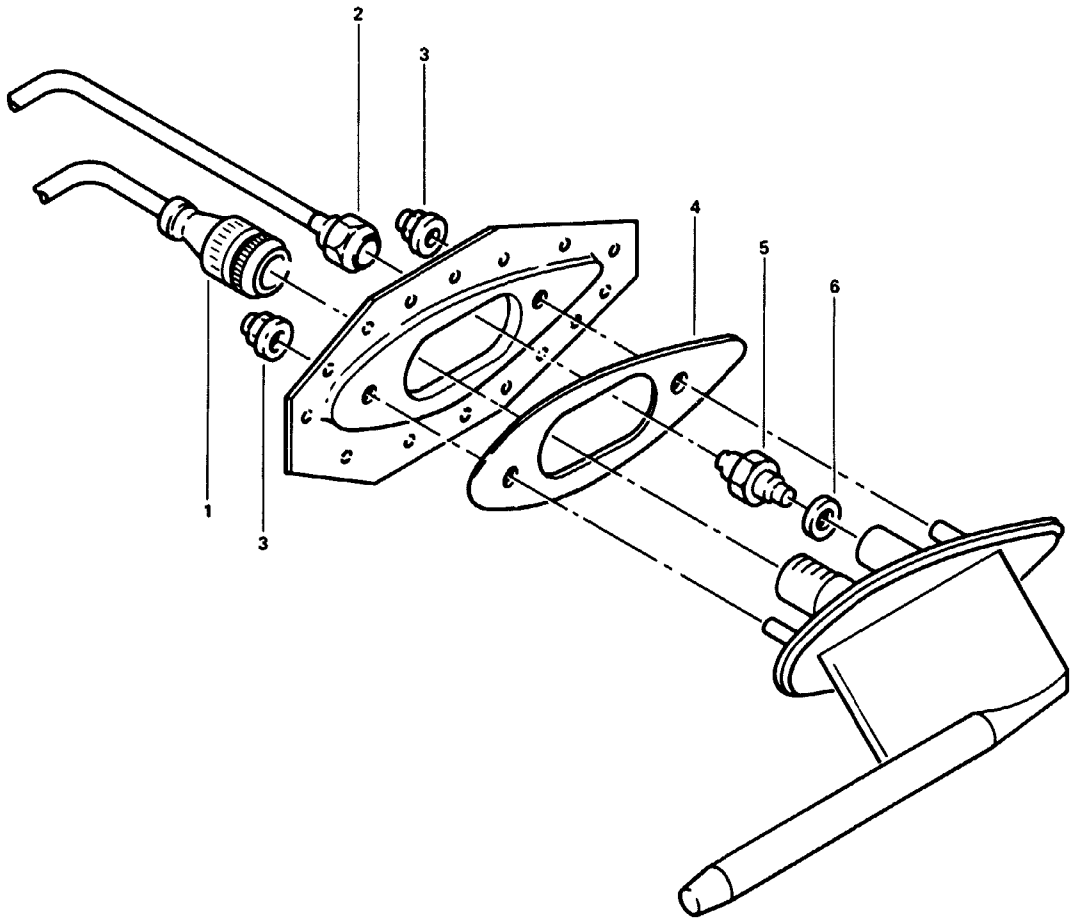
PANEL	SERVICE	IDENT.	LOCATION
22VU	PROBE HEAT/STBY PITOT SUPPLY	55DA	207/C28

(2)Position 3.00 m (10 ft) access platform below pitot probe to be removed.
(3)Open access door 121BL and gain access to pitot probe to be removed.

B. Removal

(1)Remove slip-on cover from pitot probe





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Pitot Probe
Figure 401

(2)Disconnect electrical connector (1) from pitot probe.
(3)Disconnect pressure line (2) from pitot probe.
(4)Support pitot probe to prevent it from falling, and remove two nuts (3).
(5)Withdraw pitot probe gently from fuselage.
(6)Remove union (5) and O-ring (6), discard O-ring.
(7)Remove and discard gasket (4).
(8)Cap pressure line and electrical connector.

C. Preparation of Replacement Component
(1)Install new O-ring (6).
(2)Install and tighten union (5).
R (3)Ream 6.5 mm (0.2559 in.) diameter holes of new gasket (4) to between
R 7.0 mm (0.27559 in.) and 7.1 mm (0.27952 in.).

D. Installation
CAUTION : TO PREVENT CONTAMINATION OF SYSTEM, ENSURE ABSENCE OF FOREIGN MATERIALS IN PITOT PROBE PRIOR TO INSTALLATION.
(1)Clean and inspect pitot probe interface and/or adjacent area.
(2)Remove caps from pressure line (2) and electrical connector (1).
(3)Install new gasket (4).
(4)Carefully position and engage pitot probe ; the pick-off element must be pointed towards the front of the aircraft.
(5)Support pitot probe to prevent it from falling.
(6)Install the two nuts (3) and TORQUE to between 0.6 and 0.7 m.daN (53.10 and 61.90 lbf.in.).
(7)Connect electrical connector (1) to pitot probe.
(8)Connect pressure line (2) to probe. Torque air line union nut (Ref. 20-23-12, P. Block 1)
(9)Check the bonding contact resistance between the Pitot Probe and the fuselage structure (Ref. 20-28-11, P. Block 001).
(10)Remove safety clips and tags and close the following circuit breakers :
(a)For Captain pitot probe 41DA :5DA.
(b)For First Officer pitot probe 40DA : 9DA.
(c)For standby pitot probe 42DA : 55DA.

E. Test
(1)Leak test
Carry out leak test of pitot system (Ref. 34-10-00, P. Block 501).
(2)Heating test
(a)Initial Conditions
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.
WARNING : MAKE CERTAIN THAT PROTECTIVE COVERS ARE REMOVED FROM PROBES. SERIOUS BURNS MAY OCCUR IF THE PROBES ARE HANDLED DURING OR IMMEDIATELY FOLLOWING HEATING SYSTEM TEST.
WARNING : TO AVOID DAMAGING PITOT PROBES, TEST DURATION MUST NOT EXCEED ONE MINUTE.
- Correct electrical power supply
- Forward services ventilation system in operation
- Close circuit breakers particularly those associated with ECAM and

ANTI-ICE systems
- On ECAM control panel :
press CLEAR pushbutton switch until MASTER WARN and MASTER CAUTION lights go off and MEMO page is displayed on L ECAM display unit.

ACTION	RESULT
1. On PROBE HEAT section of overhead panel, panel 433VU - press CAPT (F/O, STBY) pushbutton switch.	On panel 433VU, check that - OFF legend on CAPT (F/O, STBY) pushbutton switch goes off. - legends on CAPT (F/O, STBY) annunciators go off.
2. On C/B panel 22VU (132VU) - open PROBE HEAT/CAPT/PITOT/SUPPLY circuit breaker location 207/C24 or PROBE HEAT/STBY PITOT SUPPLY circuit breaker location 207/C28 (ANTI ICE/PROBES/F/O/PITOT circuit breaker location 322/N67)	On panel 433VU, check that - PITOT legend on CAPT (F/O, STBY) annunciator comes on. On CAPT and F/O main instrument panels 3VU and 5VU . - MASTER CAUTION lights come on - Single chime sounds. On L ECAM display unit - ANTI ICE CAPT (F/O/STBY) PITOT HEAT FAULT message is displayed.
- close circuit breaker previously opened.	On panel 433VU - PITOT legend on CAPT (F/O, STBY) annunciator goes off. On CAPT and F/O main instrument panels 3VU and 5VU : - MASTER CAUTION lights go off. On L ECAM display unit - MEMO page reappears.
3. On PROBE HEAT section of overhead panel, panel 433VU. - release CAPT (F/O, STBY) pushbutton switch.	On panel 433VU check that - OFF legend on CAPT (F/O, STBY) pushbutton switch comes on. - legends on CAPT (F/O, STBY) annunciators come on.

F. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Install pitot probe slip-on cover.
(3)Make sure that drain holes of pitot probes are not blocked by foreign materials (Ref. 34-11-15, P. Block 601).

(4)Close access door 121BL.
(5)Remove access platform.
(6)De-energize the aircraft electrical network
(Ref. 24-41-00, P. Block 301).

1. Reason for the Job
To check pitot probes for correct condition.

2. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform, 3.00 m (10 ft.)
B.	Optical Micrometer or Other Suitable Instrument
C.	Circuit Breaker Safety Clips
Referenced Procedure - 34-11-15, P. Block 401	Pitot Probes

3. Procedure

A. Job Set-Up
(1)Remove pitot probe slip-on cover

B. Check
(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT	LOCATION
22VU	PROBE HEAT/CAPT/SUPPLY	5DA	207/C24
22VU	PROBE HEAT/STBY PITOT SUPPLY	55DA	207/C28
132VU	ANTI ICE/PROBES/F/O PITOT	9DA	322/N67

**ON A/C ALL

R (Ref. Fig. 601)

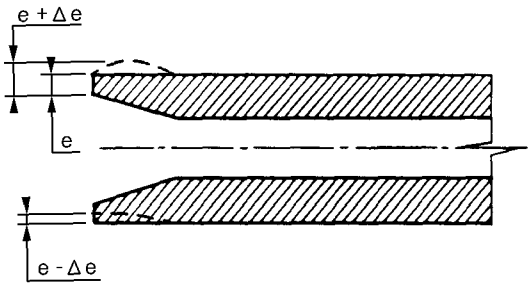
**ON A/C ALL

NOTE : If dimensions measured are close to limits below, carry out checks more frequently. If they are out of limits, remove pitot probe (Ref. 34-11-15, P. Block 401).

(2)Leading edge thickness (e)

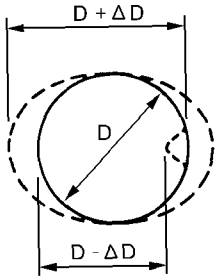
R Leading edge thickness must be : e = 0.381 ± 0.254 mm (0.015 in. ± 0.010)

(3)Flattening or local dent (D)



LEADING EDGE THICKNESS

e = 0.381mm
Δe = 0.254mm

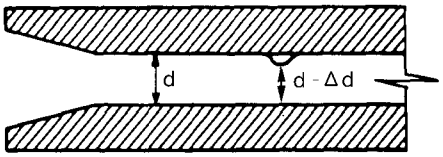


FLATTENING OR LOCAL DENT

D = 10.92mm
D + Δ D = 12.19mm
D - Δ D = 9.39mm

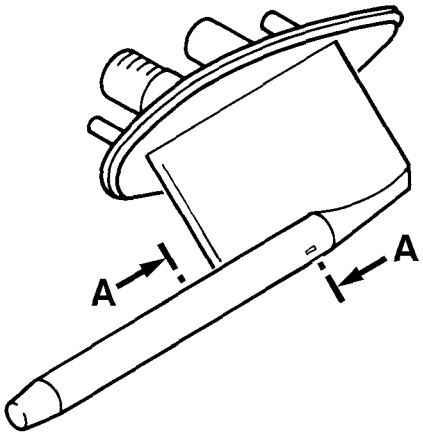
LOCAL EROSION

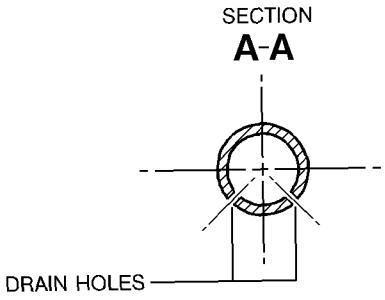
A ⩽ 6.85mm ^{2}
h ⩽ 1.52mm



INTERNAL OBSTRUCTION

d = 5.33mm
Δd = 0.50mm





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Pitot Probe Tip Configuration
Figure 601

R

Flattening or a local dent must not cause a variation in diameter as follow :
D + ΔD = 12.19 mm (0.48 in.)
D - ΔD = 9.39 mm (0.37 in.)

(4)Local erosion (h)
Local erosion must not be greater than h = 1.52 mm (0.06 in.) and (A) must be less than 6.85 mm² (0.026 in.).

(5)Internal obstruction (d)
Internal diameter must not be less than d - 0.50 mm (0.02 in.) with d = 5.33 mm (0.21 in.).

CAUTION : DO NOT USE SHARP AND/OR METAL TOOLS OR OBJECTS TO CLEAN THE PITOT PROBE. SUCH TOOLS OR OBJECTS CAN CAUSE DAMAGE TO THE PITOT PROBE.

Make sure that the pitot probe is clean, without obstruction. If not, remove the pitot probe (Ref. 34-11-15, P. Block 401), blow compressed air into the pitot tube at the pneumatic connector and out of the tube entrance.
Maximum air pressure 57 psi (3.9300 bar)

NOTE : The compressed air line must have an oil trap to make sure that no oil gets into the pitot probe.

Install the pitot probe (Ref. 34-11-15, P. Block 401).

(6)Drain holes
Make certain that drain holes are not blocked.

C. Close-Up
(1)Install pitot probe slip-on cover.
(2)Remove tool and access platform.
(3)Remove safety clips and tags and circuit breakers 5DA, 55DA and 9DA.

STATIC PROBE 34DA (35DA, 36DA, 37DA, 38DA, 39DA)
REMOVAL/INSTALLATION

NOTE : As removal/installation procedures for the six static probes are identical, these procedures are described for static probe 34DA only.

1. Equipment and Materials

	ITEM	DESIGNATION
	A.	Access Platform, 3.00 m (10 ft.)
	B.	Circuit Breaker Safety Clips
	C.	Blanking Plugs
	D.	O-Ring
	E.	Gasket
R	F.	Torque Wrench : range 0.00 to 1.20 m.daN
R		(0.00 to 9.00 lbf.ft)
R	G.	Corrosion-resistant stell lockwire 0.8 mm
R		(0.032 in.) dia.
R	Material No. 09-016	USA MIL-PFR-81733D
R		Polysulfide sealant N-K0113 (Ref. 20-31-00)
R	Material No. 11-003	USA ASTM D 740
R		METHYL-ETHYL-KETONE (Ref. 20-31-00)
	Referenced Procedures	
	- 34-10-00, P. Block 501	Flight Environment Data
	- 20-23-12, P. Block 1	Specified Torque Values for Unions
	- 24-41-00, P. Block 301	AC External Power Control

2. Procedure

WARNING : MAKE SURE THAT THE CIRCUIT BREAKER(S) RELATED TO THE WEATHER RADAR IS (ARE) OPENED, SAFETIED AND TAGGED.

R (Ref. Fig. 401)

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

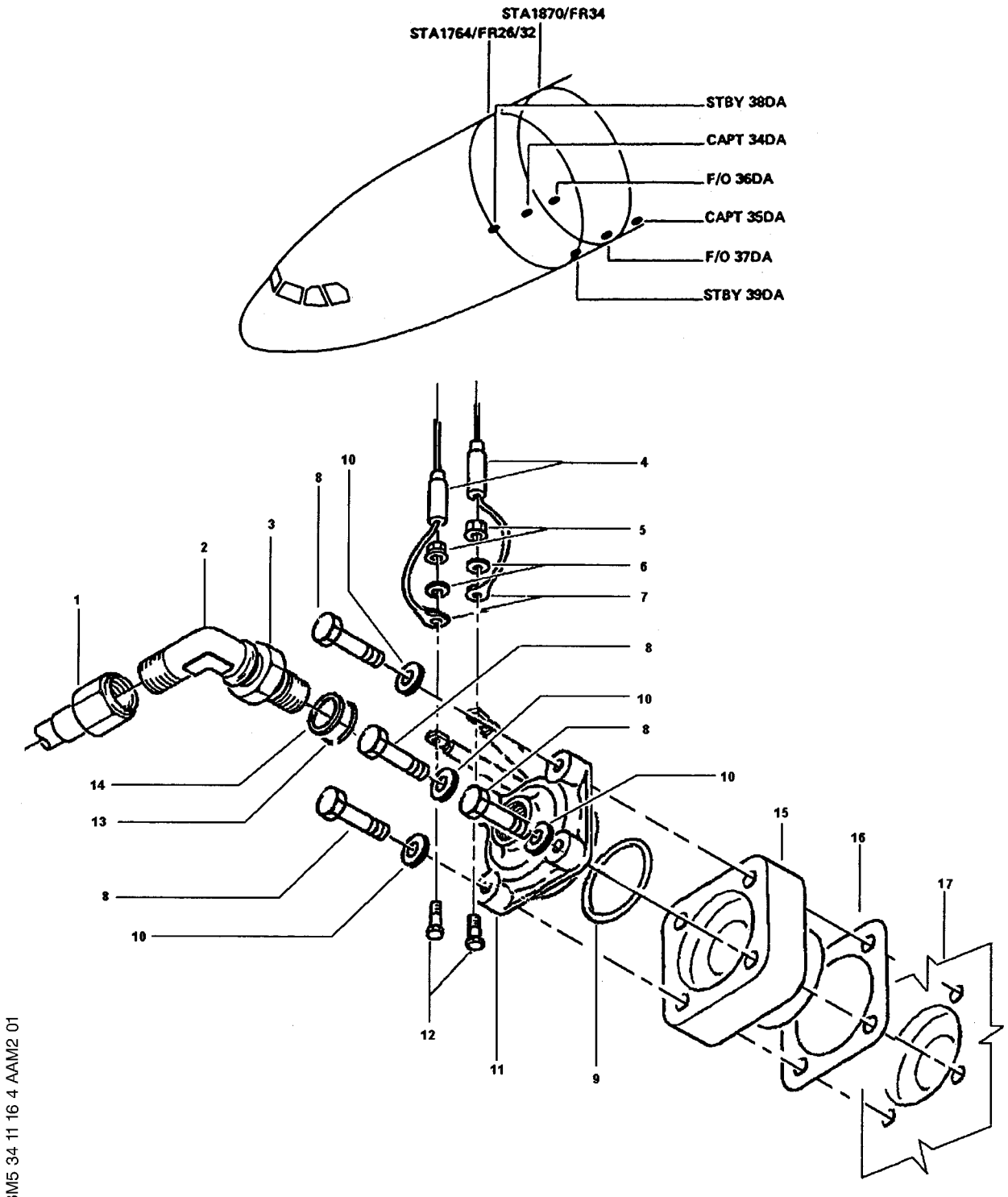
(a)For static probe 34DA.

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES/CAPT R STAT	3DA	321/P69

(b)For static probe 35DA.

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES/CAPT L STAT	4DA	322/N68

(c)For static probe 36DA.



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Air Data System : Static Probe
Figure 401

R

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES/F/O R STAT	7DA	322/N69

(d)For static probe 37DA.

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES/F/O L STAT	8DA	323/M66

(e)For static probe 38DA.

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES/STBY R STAT	15DA	323/M67

(f)For static probe 39DA.

PANEL	SERVICE	IDENT.	LOCATION
132VU	ANTI ICE/PROBES/STBY L STAT	14DA	321/P68

(2)Position access platform at access door 811 at forward cargo compartment.
(3)Open access door 811.
(4)In forward cargo compartment remove the following access doors.
(a)131MW for access to static probes 35DA, 37DA, 39DA.
(b)132MW for access to static probes 34DA, 36DA, 38DA.

B. Removal

R (1)Removal of static probe
R (a)Slide protective covers (4) along wires.
R (b)Remove nuts (5), washers (6) and screws (12).
R (c)Loosen nut (1). Disconnect air line and protect with blanking plug.
R (d)Loosen nut (3) and remove elbow (2). Retain elbow assembly.
R (e)Remove and discard O-ring (13) and seal (14).
R (f)Remove and discard lockwire from bolts (8).
R (g)Remove and retain bolts (8) and washers (10).
R (h)Remove static probe (11), remove and discard O-ring (9).
R (j)Retain static port (15) and shim (16).

C. Preparation of Replacement Component

(1)Replacement static probe must show no traces of corrosion or of protective material. It must show no faults or signs of damage.
R (2)Remove used sealant with non metallic scraper.
R (3)Clean component interface and/or adjacent area with
R CLEANING AGENTS (Material No. 11-003) and lint-free cloth.
R (4)Do a visual inspection of component interface and/or adjacent area.
R NOTE : Make certain that contact areas of static port (15) and
R static probe (11) have no signs of paint, corrosion or sealant.

D. Installation

R (1)Apply sealant (Material No. 09-016) to mouting surface (17).
R (2)Apply sealant (Material No. 09-016) to mouting surface of static port (15).
R (3)Install shim (16).
R (4)Install static port (15).
R (5)Install new O-ring (9).
R (6)Carefully position static probe (11) on static port (15) with heating element towards rear of aircraft.
R (7)Install bolts (8) and washers (10) and tighten diagonally to a torque value of 0.4 m.daN (35.39 lbf.in.).
R (8)Safety bolts (3) with corrosion-resistant steel Lockwire 0.8mm. (0.032in.) dia.
R (9)Install tags (7) on screws (12) with washers (6) and nuts (5). Install protective covers (4).
R (10)Install new O-ring (13) and new seal (14).
R (11)Position and install elbow (2). Tighten nut (3) to a torque value of 0.1 m.daN (8.85 lbf.in.).
R (12)Remove blanking plug. Connect air line. Tighten nut (1) to a torque value of 0.1 m.daN (8.85 lbf.in.). TORQUE air line union nut (Ref. 20-23-12, P. Block 001).
R (13)Remove safety clips and tags and close the following circuit breakers :
(a)Circuit breaker 3DA for static probe 34DA.
(b)Circuit breaker 4DA for static probe 35DA.
(c)Circuit breaker 7DA for static probe 36DA.
(d)Circuit breaker 8DA for static probe 37DA.
(e)Circuit breaker 15DA for static probe 38DA.
(f)Circuit breaker 14DA for static probe 39DA.

E. Test

(1)Leak test
Carry out leak test of Static System (Ref. 34-10-00, P. Block 501). At completion of test, do not de-energize electrical network.
(2)Heating test
(a)Initial Conditions
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.
WARNING : MAKE CERTAIN THAT PROTECTIVE COVERS ARE REMOVED FROM PROBES. SERIOUS BURNS MAY OCCUR IF THE PROBES ARE HANDLED DURING OR IMMEDIATELY FOLLOWING HEATING SYSTEM TEST.
WARNING : TO AVOID DAMAGING STATIC PROBES, TEST DURATION MUST NOT EXCEED ONE MINUTE.
- Make certain that circuit breakers are closed, particularly those associated with ECAM and ANTI-ICE systems.
- On ECAM control panel
- press CLR pushbutton switch until MASTER WARN and MASTER CAUTION lights go off and MEMO page is displayed on L ECAM display unit.

ACTION	RESULT
1. On PROBE HEAT section of overhead panel, panel 433VU - press CAPT (F/O STBY) pushbutton switch	On panel 433VU, check that : - OFF legend on CAPT (F/O, STBY) pushbutton switch goes off. - legends on CAPT (F/O, STBY) annunciators go off.
2. On panel 132VU - open ANTI ICE/PROBES/CAPT L STAT (R STAT) circuit breaker, location 321/P69 (322/N68) or ANTI-ICE/PROBES/F/O L STAT (R STAT) circuit breaker, location 322/N69 (323/M 66) or ANTI-ICE/PROBES/STBY L STAT (R STAT) circuit breaker, location 323/M67 (321/P68).	On panel 433VU, check that : - L STAT (R STAT) legend on CAPT (F/O, STBY) annunciator comes on. On CAPT and F/O main instrument panels 3VU and 5VU - MASTER CAUTION lights come on - Single chime sounds. On L ECAM display unit - ANTI ICE - CAPT (F/O, STBY) STAT HEAT FAULT message is displayed.
- close circuit breaker previously opened.	On panel 433VU - L STAT (R STAT) legend on CAPT (F/O, STBY) annunciator goes off. On CAPT and F/O main instrument panels 3VU and 5VU - MASTER CAUTION lights go off On L ECAM display unit - MEMO page reappears.
3. On PROBE HEAT section of overhead panel, panel 433VU - release CAPT (F/O, STBY) pushbutton switch	On panel 433VU, check that : - OFF legend on CAPT (F/O, STBY) pushbutton switch comes on. - legends on CAPT (F/O, STBY) annunciators come on.

F. Close-Up

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Install access door 131MW for 35DA, 37DA, 39DA or 132MW for 34DA, 36DA, 38DA.

(3)Close access door 811 and remove access platform.

(4)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

TOTAL AIR TEMPERATURE PROBE 11FL1 (11FL2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.60 m (8 ft. 7 in.)
B.	Circuit Breaker Safety Clips
C.	Blanking Plugs/Caps
D.	Gasket
Referenced Procedures	
- 30-31-00, P. Block 501	Probe Ice Protection
- 34-10-00, P. Block 501	Flight Environment Data

(Ref. Fig. 401)

2. Procedure

WARNING : MAKE SURE THAT THE CIRCUIT BREAKER(S) RELATED TO THE WEATHER RADAR IS (ARE) OPENED, SAFETIED AND TAGGED.

A. Job Set-Up

(1)Position access platform below the total air temperature probe.

(2)Open, safety and tag the following circuit breakers :

(a)For total air temperature probe 11FL1

PANEL	SERVICE	IDENT.	LOCATION
22VU	MIN EQPT BAY SUPPLY/ADS/ADC1/115VAC	9FL1	208/B19
132VU	ANTI ICE/PROBES/CAPT/TAT	2DA	325/K69

(b)For total air temperature probe 11FL2

PANEL	SERVICE	IDENT.	LOCATION
21VU	ADS/ADC2/115VAC	9FL2	105/E10
132VU	ANTI ICE/PROBES/F/O/TAT	7ODA	323/M72

B. Removal

(1)Remove slip-on cover from TAT probe

(2)Remove the six attachment screws (4).

(3)Pull probe straight out from fuselage until electrical connector (1) is visible.

(4)Disconnect electrical connector (1).

(5)Cap electrical connectors (1) and (5).

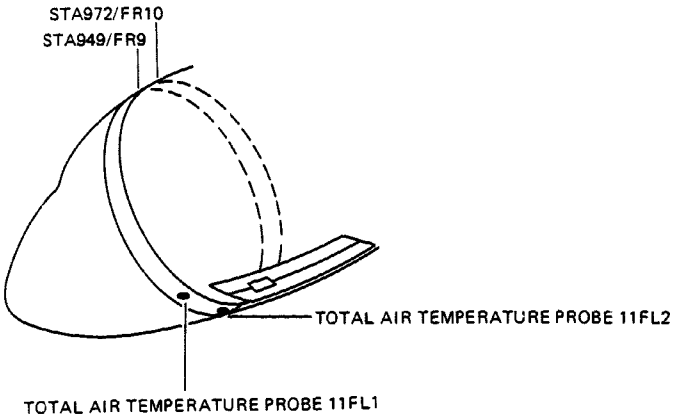
(6)Remove and discard gasket (2).

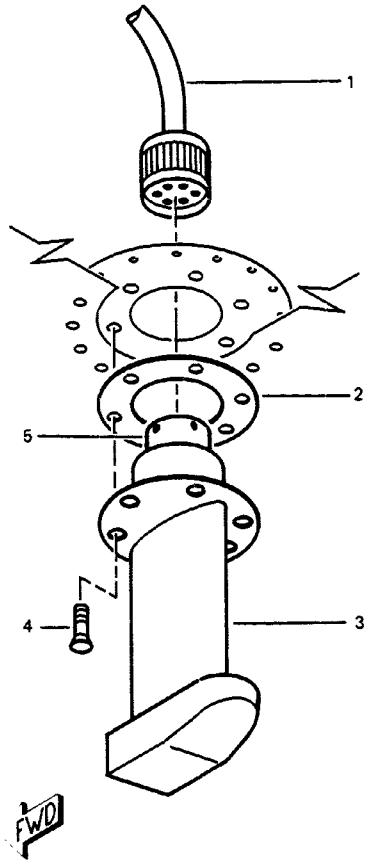
(7)Remove probe (3).

C. Installation

(1)Clean and inspect probe interface and/or adjacent area.

(2)Remove blanking caps from electrical connectors and check for correct condition of electrical connectors (1) and (5).





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Total Air Temperature Probe
Figure 401

(3)Install gasket (2) on temperature probe (3) and connect electrical connector (1).
(4)Slide cable inside the aircraft and install base of probe in its housing.
(5)Install the six attachment screws (4); make certain that gasket is properly positioned, and tighten screws.
(6)Check the bonding contact resistance between the TAT Probe (3) and the fuselage structure (Ref. 20-28-11, P. Block 001).
(7)Remove safety clips and tags and close the following circuit breakers :
(a)For probe 11FL1 : 9FL1 and 2DA
(b)For probe 11FL2 : 9FL2 and 7ODA

D. Test
(1)Carry out Total Air Temperature Test (Ref. 34-10-00, P. Block 501).
(2)Carry out an operational test of TAT heating (Ref. 30-31-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Remove access platform.

TOTAL AIR TEMPERATURE PROBE 11FL1 (11FL2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.60 m (8 ft. 7 in.)
B.	Circuit Breaker Safety Clips
C.	Blanking Plugs/Caps
D.	Gasket
Referenced Procedures	
- 30-31-00, P. Block 501	Probe Ice Protection
- 34-10-00, P. Block 501	Flight Environment Data

(Ref. Fig. 401)

2. Procedure

WARNING : MAKE SURE THAT THE CIRCUIT BREAKER(S) RELATED TO THE WEATHER RADAR IS (ARE) OPENED, SAFETIED AND TAGGED.

A. Job Set-Up

(1)Position access platform below the total air temperature probe.

(2)Open, safety and tag the following circuit breakers :

(a)For total air temperature probe 11FL1

PANEL	SERVICE	IDENT.	LOCATION
22VU	MIN EQPT BAY SUPPLY/ADS/ADC1/115VAC	9FL1	208/B19
132VU	ANTI ICE/PROBES/CAPT/TAT	2DA	325/K69

(b)For total air temperature probe 11FL2

PANEL	SERVICE	IDENT.	LOCATION
21VU	ADS/ADC2/115VAC	9FL2	105/E10
132VU	ANTI ICE/PROBES/F/O/TAT	7ODA	323/M72

B. Removal

(1)Remove slip-on cover from TAT probe

(2)Remove the six attachment screws (4).

(3)Pull probe straight out from fuselage until electrical connector (1) is visible.

(4)Disconnect electrical connector (1).

(5)Cap electrical connectors (1) and (5).

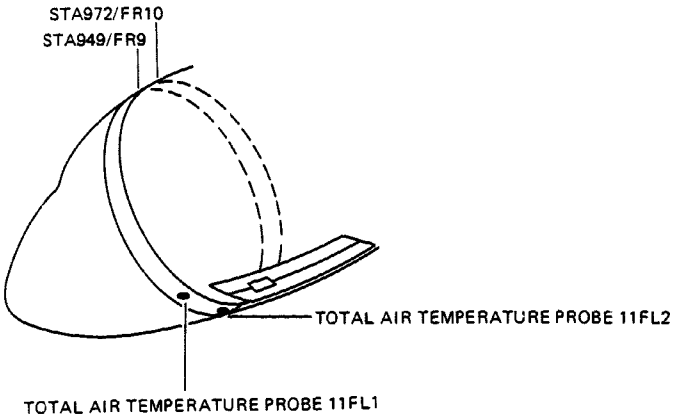
(6)Remove and discard gasket (2).

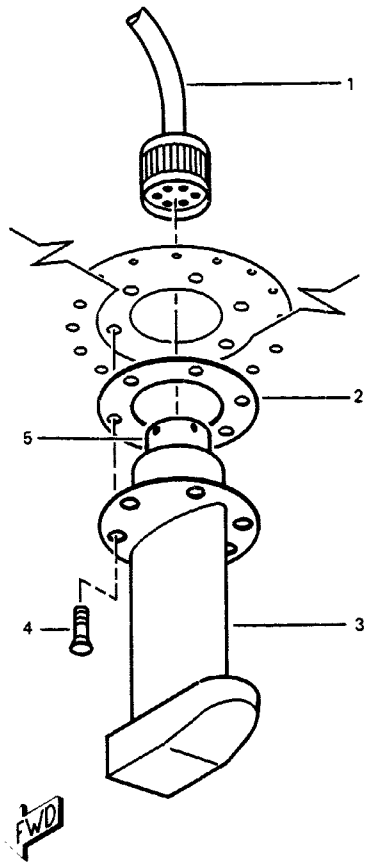
(7)Remove probe (3).

C. Installation

(1)Clean and inspect probe interface and/or adjacent area.

(2)Remove blanking caps from electrical connectors and check for correct condition of electrical connectors (1) and (5).





BM5 34 11 18 4 AAM2

Total Air Temperature Probe
Figure 401

(3)Install gasket (2) on temperature probe (3) and connect electrical connector (1).
(4)Slide cable inside the aircraft and install base of probe in its housing.
(5)Install the six attachment screws (4); make certain that gasket is properly positioned, and tighten screws.
(6)Check the bonding contact resistance between the TAT Probe (3) and the fuselage structure (Ref. 20-28-11, P. Block 001).
(7)Remove safety clips and tags and close the following circuit breakers :
(a)For probe 11FL1 : 9FL1 and 2DA
(b)For probe 11FL2 : 9FL2 and 7ODA

D. Test
(1)Carry out Total Air Temperature Test (Ref. 34-10-00, P. Block 501).
(2)Carry out an operational test of TAT heating (Ref. 30-31-00, P. Block 501).

E. Close-Up
(1)Install TAT probe slip-on cover.
(2)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(3)Remove access platform.

ALPHA PROBES 48FL1, 48FL2 - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.6 m (8.75 ft.)
B.	Circuit Breaker Safety Clips
C.	Blanking Caps
D.	Gasket
E. Material No. 09-029	Sealants (Ref. 20-31-00)
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-10-00, P. Block 501	Flight Environment Data

(Ref. Fig. 401)

2. Procedure

WARNING : MAKE CERTAIN THAT THE CIRCUIT BREAKER(S) RELATED TO THE WEATHER RADAR IS (ARE) OPENED, SAFETIED AND TAGGED.

NOTE : As removal/installation procedures are identical for both ALPHA probes 48FL1 and 48FL2, these procedures will be described for 48FL1 only.

A. Job Set-Up

(1)Install access platform below ALPHA probe to be removed.

(2)Open, safety and tag the following circuit breakers :

(a)For ALPHA probe 48FL1 :

PANEL	SERVICE	IDENT.	LOCATION
21VU	ADS/ADC & ALPHA PROBES TEST/PWR	28FL	105/E07
22VU	PROBE HEAT/CAPT/ALPHA SUPPLY	1DA	207/C25
22VU	ADS/ADC1/26VAC	8FL1	208/B20

(b)For ALPHA probe 48FL2 :

PANEL	SERVICE	IDENT.	LOCATION
21VU	ADS/ADC & ALPHA PROBES TEST/PWR	28FL	105/E07
21VU	ADS/ADC2/26VAC	8FL2	105/E09
132VU	ANTI-ICE/PROBES/F/O/ALPHA	51DA	323/M71

B. Removal

(1)Remove the seven attaching screws (8) from blanking plate (6) and remove it.

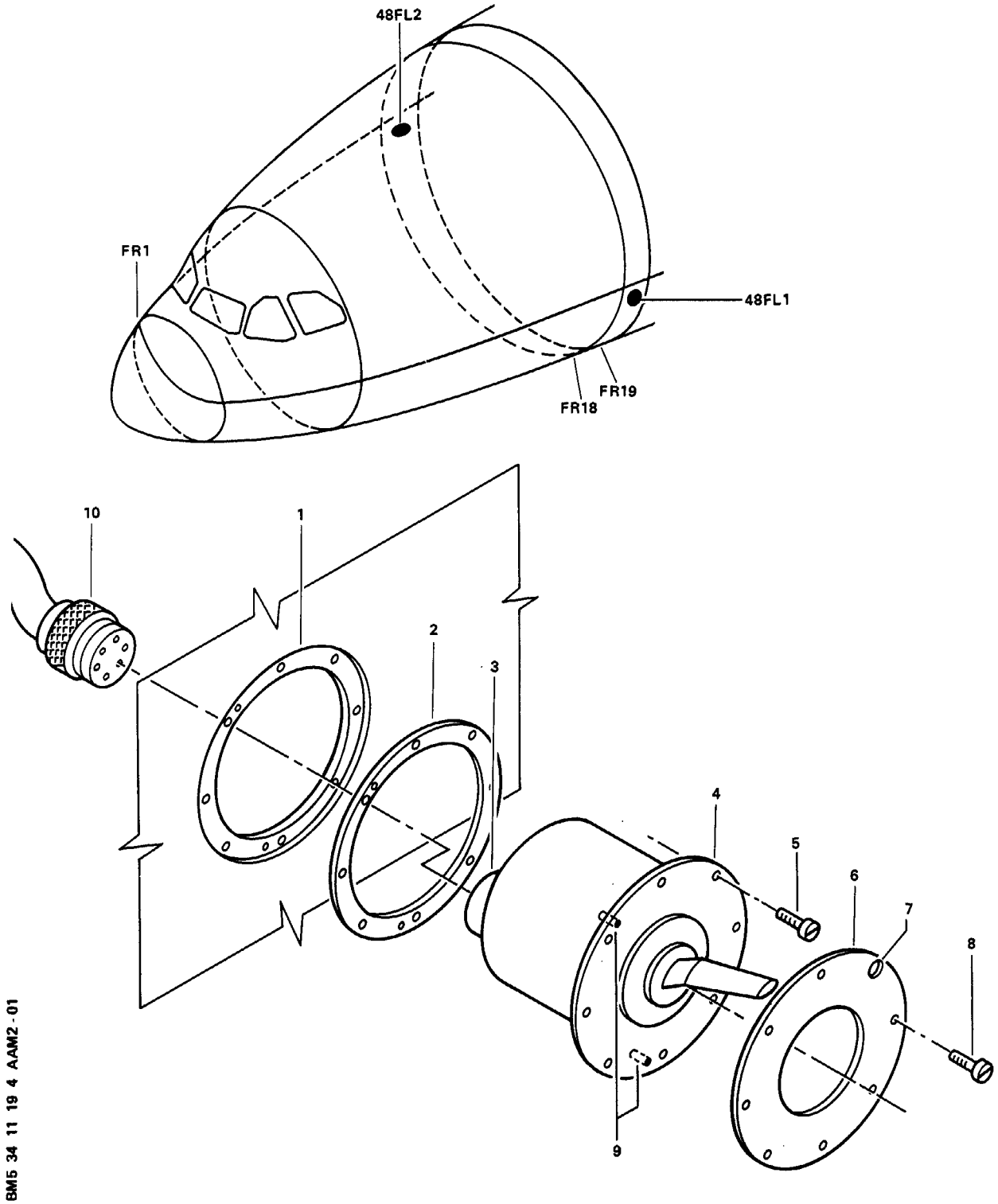
(2)Remove the attaching screw (5) from probe (4).

(3)Disengage probe (4) until connector (3) is visible and accessible.

(4)Disconnect and blank off connectors (3) and (10).

(5)Remove probe (4).

(6)Remove and discard O-ring (2).



ALPHA Probes

R Figure 401

C. Installation
(1)Clean and inspect O-ring ALPHA probe interface and/or adjacent area.
(2)Install new O-ring (2) in recess (1).
(3)Remove blanking caps from electrical connectors (3) and (10) and visually check pins for correct condition.
(4)Connect electrical connectors.
(5)Install probe (4) using locating pins (9), and tighten screw (5).
(6)Install blanking plate (6) and tighten the seven screws (8).
(7)Blank the eighth hole (7) off with Sealant (Material No. 09-029).
(8)Apply a sealing bead around the blanking plate (6) with Sealant (Material No. 09-029).

R NOTE : If the cure time of the sealant will cause a flight delay, the
R aircraft can fly for a maximum of 24 hours without the sealant.
R Before application of the sealant, it is necessary to make
R certain that the surfaces are clean and in the correct condition
R (no moisture, dust, etc.).

(9)Check the bonding contact resistance between the ALPHA Probe (4) and the fuselage structure (1) (Ref. 20.28-11, P. Block 001).
(10)Remove safety clips and tags and close the following circuit breakers.
(a)for probe 48FL1 : 1DA, 28FL and 8FL1
(b)for probe 48FL2 : 51DA, 28FL and 8FL2.

D. Test
(1)Carry out ALPHA Probes Test (Ref. 34-10-00, P. Block 501).
(2)Heating test
(a)Initial conditions

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

WARNING : MAKE CERTAIN THAT PROTECTIVE COVERS ARE REMOVED FROM PROBES. SERIOUS BURNS MAY OCCUR IF THE PROBES ARE HANDLED DURING OR IMMEDIATELY FOLLOWING HEATING SYSTEM TEST.

WARNING : TO AVOID DAMAGING STATIC PROBES, TEST DURATION MUST NOT EXCEED ONE MINUTE.

- Correct electrical power supply.
- Close circuit breakers particularly those associated with ECAM and ANTI-ICE systems.
- On ECAM control panel :
  press CLR pushbutton switch until MASTER WARN and MASTER CAUTION lights go off and MEMO page is displayed on L ECAM display unit.

ACTION	RESULT
1. On PROBE HEAT section of overhead panel, panel 433VU - press CAPT (F/O, STBY) pushbutton switch	On panel 433VU, check that : - OFF legend on CAPT (F/O, STBY) pushbutton switch goes off

ACTION	RESULT
	- legends on CAPT (F/O, STBY) annunciators go off.
2. On C/B panel 22VU (On C/B panel 132VU) - open PROBE HEAT/CAPT/ALPHA SUPPLY circuit breaker, location 207/C25 (ANTI ICE/PROBES/F/O ALPHA circuit breaker, location 323/M71) (ANTI ICE/PROBES/STBY ALPHA circuit breaker, location 325/K68)	On panel 433VU, check that : - ALPHA legend on CAPT (F/O, STBY) annunciator comes on On CAPT and F/O main instrument panels 3VU and 5VU - MASTER CAUTION lights come on. - single chime is heard On L ECAM display unit - ANTI ICE CAPT(F/O, STBY) ALPHA HEAT FAULT message is displayed.
- close circuit breaker previously opened	On panel 433VU - ALPHA legend on CAPT (F/O, STBY) annunciator goes off On CAPT and F/O main instrument panels 3VU and 5VU - MASTER CAUTION lights go off On L ECAM display unit - MEMO page reappears.
3. On PROBE HEAT section of overhead panel, panel 433VU - release CAPT (F/O, STBY) pushbutton switch	On panel 433VU, check that : - OFF legend on CAPT (F/O, STBY) pushbutton switch comes on - legends on CAPT (F/O, STBY) annunciators come on.

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Install ALPHA probe slip-on cover.
(3)Remove access platform.
(4)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-10-00, P. Block 501	Flight Environment Data

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :
(a)For ADC1

PANEL	SERVICE	IDENT.	LOCATION
22VU	MIN EQPT BAY SUPPLY/ADS/ADC1/115VAC	9FL1	208/B19
22VU	MIN EQPT BAY SUPPLY/ADS/ADC1/26VAC	8FL1	208/B20

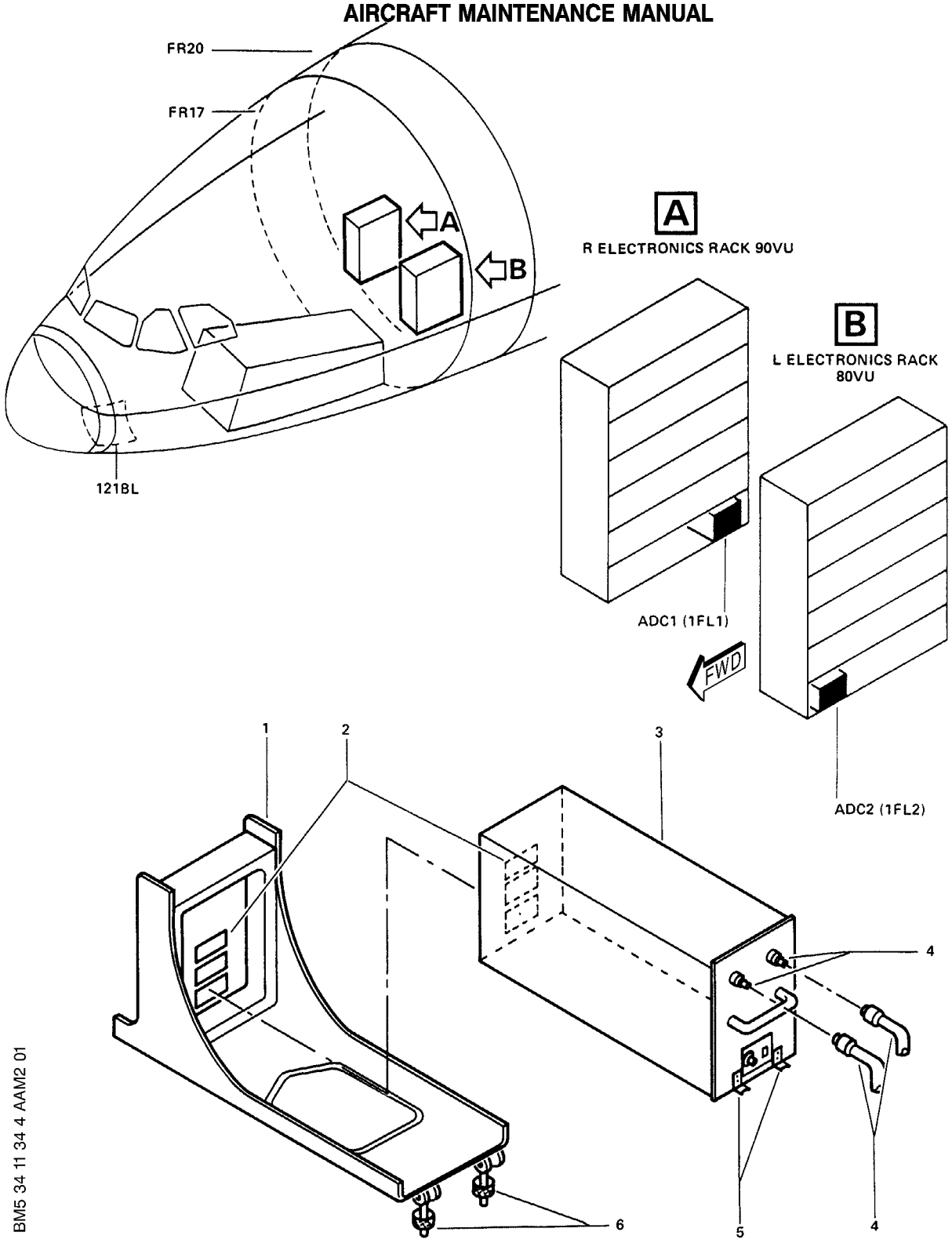
(b)For ADC2

PANEL	SERVICE	IDENT.	LOCATION
22VU	ADS/ADC2/BARO SET	55FL1	208/B18
21VU	ADS/ADC2/26VAC	8FL2	105/E 9
21VU	ADS/ADC2/115VAC	9FL2	105/E10

(2)Open access door 121BL and gain access to avionics compartment.
(3)Gain access to ADC to be removed (for ADC1 on shelf 96VU remove side panel of minimum equipment bay).

B. Removal
(1)Disconnect Quick-Attach-Detach (QAD) connectors (4).
(2)Cap QADs (4).
(3)Unscrew knurled nuts (6) at front of mount (1) and tilt them downwards.
(4)Withdraw ADC (3) from mount (1).
(5)Cap electrical connectors (2).
(6)Remove ADC (3).

C. Installation
(1)Clean and inspect ADC interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (2).
(3)Check electrical connectors (2) for correct condition.
(4)Slide ADC into position in mount (1).
(5)Engage knurled nuts (6) in studs (5) and tighten.
(6)Remove blanking caps from QADs.



Air Data Computer
Figure 401

R

(7)Check QADs (4) and hoses for correct condition.
R (8)Connect QADs.
R NOTE : After the connection :
R - make certain that a colored ring is shown on the QAD connec-
R tors
R - pull the connectors to make certain that they are connected
R correctly.
(9)Remove safety clips and tags and close the following circuit breakers :
(a)For ADC1 : 9FL1, 8FL1
(b)For ADC2 : 55FL1, 8FL2 and 9FL2.

D. Test
Carry out BITE TEST of ADS1 (2) (Ref. 34-10-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)For ADC1 install side panel of minimum equipment bay.
(3)Close access door 121BL.

ALTITUDE - DESCRIPTION AND OPERATION

1. General

The altitude data is supplied to the main altimeters by both ADCs, in the digital format.

The Captain's altimeter is normally supplied through data bus No.1 from ADC1, and through data bus No.2 from ADC2 in case of emergency.

The First Officer's altimeter is normally supplied through data bus No.1 from ADC2, and through data bus No.2 from ADC1 in case of emergency.

The standby altimeters are directly supplied with static pressure.

2. Main Altimeter

A. Description and Operation

This indicator is contained in a 3 ATI-S case and provides altitude display with ± 5 ft. accuracy by means of :

- a pointer (item 3) which completes one revolution of the dial for 1000 feet
- a counter (items 2 and 9) made up of four drums graduated in tens of
R thousands, hundreds and units (in twenty-feet graduations) of feet.

When the altitude is below 10.000 ft., the drum (item 9) which indicates the tens of thousands of feet displays black and white stripes.

When the altitude is negative, a black shutter marked NEG covers the counter (items 2 and 9).

A warning light (item 1) comes on whenever altitude alert warning is triggered.

R A knob (item 4) enables display of the reference used for baro correction within the range of 745 to 1050 mb (22 to 31 in. Hg).

This correction is displayed on two counters (item 5), one graduated in millibars, the other in inches of Mercury ; it is transmitted to each ADC through resolvers.

When BARO set knob (item 4) is pressed, the altitude reading is corrected with respect to that reference pressure whatever the position of ADC INST pushbutton switch.

When BARO set knob (item 4) is released, the baro correction display counters are masked by a blue shutter marked STD.

In this case, the altitude displayed is the standard altitude corrected with respect to a barometic pressure of 1013,25 mb (29,92 in. Hg).

R A knob (item 6) controls an index (item 7) which moves around the edge of the dial (item 8).

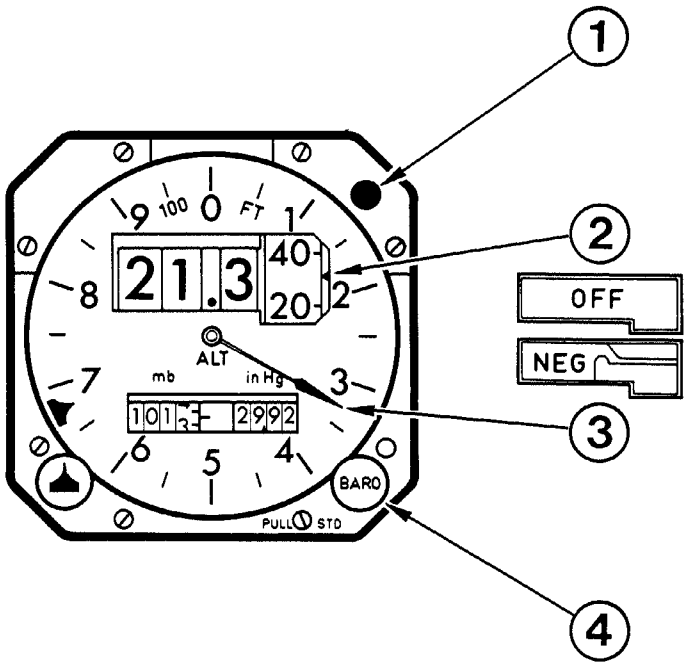
A red warning flag marked OFF covers the altitude counter (items 2 and 9) when

. the indicator is not supplied
. an internal failure or a fault in the message received is detected by the monitoring channel.

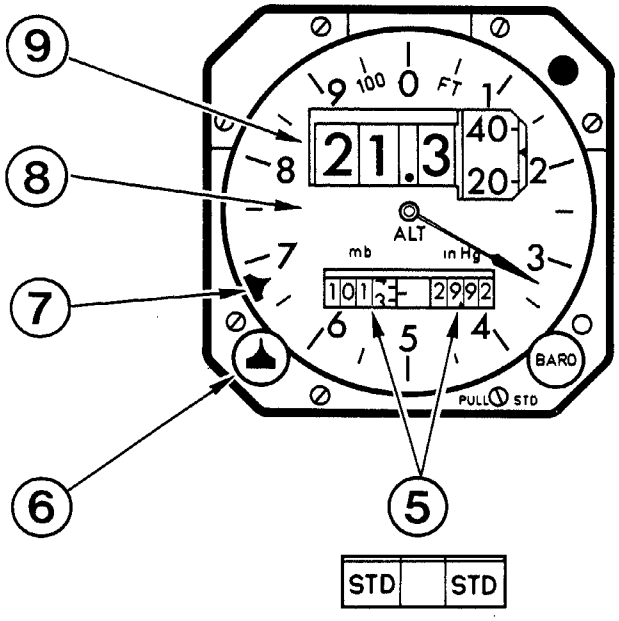
The display of this warning flag triggers

. MASTER CAUTION lights on CAPT and F/O main instrument panels 3VU and 5VU
. NAV ADC, CAPT ALTI FAULT or F/O ALTI FAULT message on L ECAM display unit
. single-stroke chime aural warning.

(Ref. Fig. 001)



- 1 - ALTITUDE ALERT WARNING LIGHT (AMBER)
- 2 - ALTITUDE DISPLAY COUNTER
- 3 - ALTITUDE POINTER
- 4 - BARO SET KNOB



- 5 - BARO SET COUNTERS
- 6 - ALTITUDE SET KNOB
- 7 - ALTITUDE SET INDEX
- 8 - ALTITUDE DIAL
- 9 - BELOW 10.000 FEET INDICATION

BM5 34 12 00 0 SAE0 02

Main Altimeter
Figure 001

R

B. Principle of Operation

(1)Input Data

Standard altitude (label 203) or baro corrected altitude (label 204 or 220) ARINC 429 digital data from the ADC is received on the input data bus. These signals are adapted and shaped to be transmitted to the LSI the function of which is to ensure the reception interface with the microprocessor of the digital processing unit.

The altitude data is converted into two input angular values which correspond to the values of the electrical angles of two dummy resolvers (coarse and fine) having the same scale factor and the same multiplication ratio as the output bootstrap resolvers. Each of these two angular values is converted into sine and cosine digital values.

(2)Bootstrap Data (Output)

Two resolvers (coarse and fine) repeat the mechanical output of the altitude display. The output electrical signals are generated from alternating 400 Hz voltage.

These signals represent, in amplitude and phase, the sine and cosine of the bootstrap angle.

These voltages are multiplexed, sampled, then converted into digital values by an analog/digital conversion channel.

(3)Computation of Angular Errors

The input sine/cosine digital angular values are compared with the output sine/cosine digital angular values (recopy). The error signal which is thus determined triggers the motor control order.

This control order is converted into a continuous signal by the digital/analog converter, then it is applied to the servomotor through a control circuit. The servomotor drives the analog display pointer, the altitude counter and two bootstrap resolvers until the error signal is zeroed (the output signal is then equal to the input signal).

(4)Barometric Pressure Display

The barometric display module enables the barometric pressure correction value to be manually displayed on two counters, in millibars and in inches of mercury, through BARO set knob. This value is transmitted to both ADCs, in sine and cosine resolver voltage form.

(5)Standard Altitude

A two-position switch, actuated by BARO set knob, enables the control of the digital data processing unit which will select the reception of standard altitude. This is indicated by a blue flag marked STD covering the barometric display counters.

R (6)Bus switching

ADC INST pushbutton switches located on LH and RH instrument panels 402VU and 406VU enable switching of Captain's altimeter to ADC2, and First Officer's altimeter to ADC1.

Depending on

- the switching discrete status
- whether BARO knob selects or not the standard altitude, the altimeter reproduces the data contained in the input bus and indicated in table 1.

TABLE 1

DISPLAY CONTROLS		DISPLAYED ALTITUDE	BAROMETRIC COUNTERS	VALIDITY "STD"
Bus Switching Discrete	STD Manual Switching			
OV or disconnected NORMAL	Switch pressed	Baro-corrected 1 Label 204 on normal bus	PRESSURE DISPLAYED	"OPEN"
	Switch released	Standard Label 203 on normal bus	Masked by STD flag (1013.25 mb)	"GROUND"
+ 28 V	Switch pressed	Corrected 2 Label 220 on alternate bus	IN VIEW	"OPEN"
ALTERNATE	Switch released	Standard Label 203 on alternate bus	Masked by STD flag (1013.25 mb)	"GROUND"
Barometric Correction		Two analog outputs indicate status of barometric counters		

Altimeter - Operation Table

(Ref. Fig. 002)

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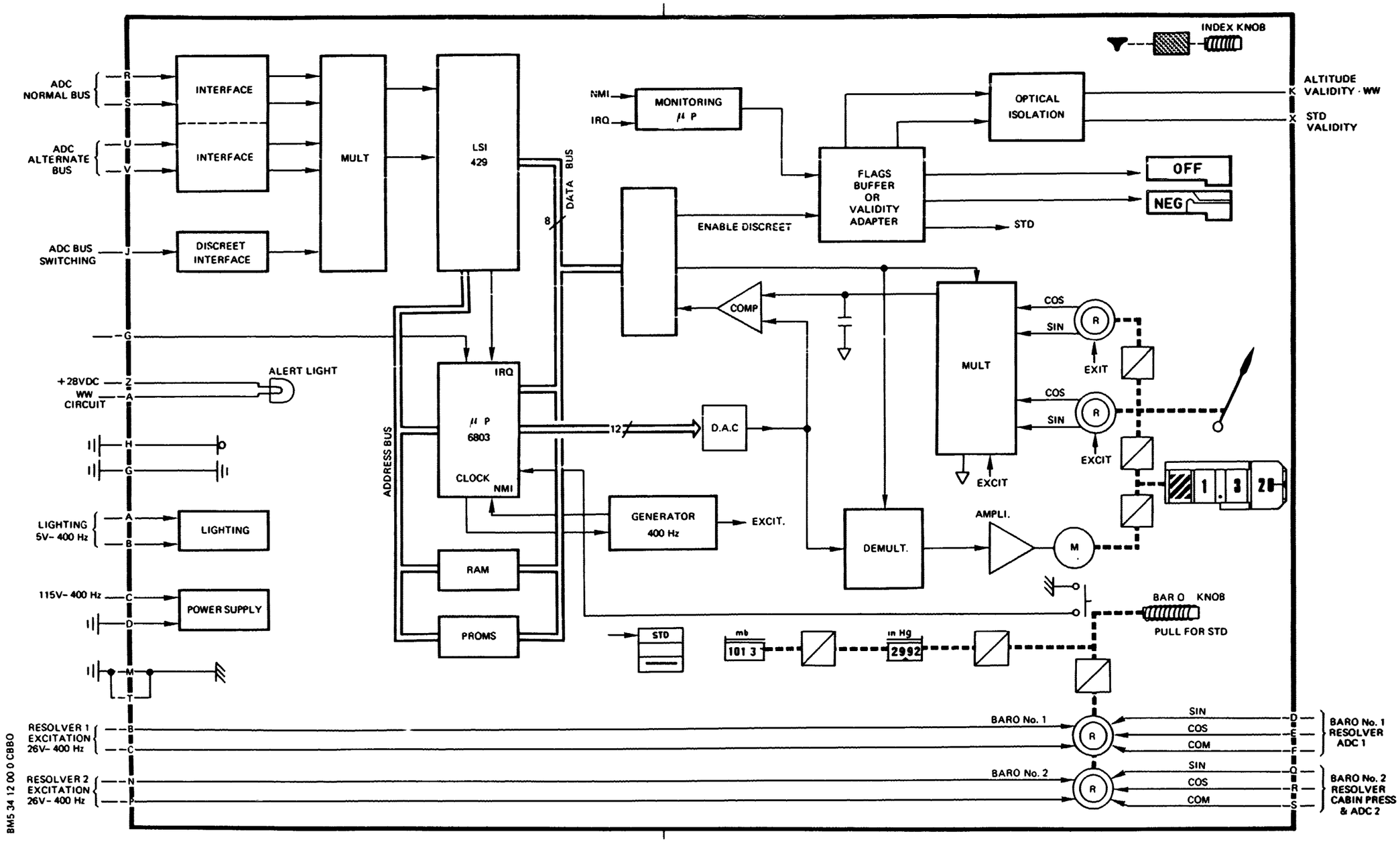

Altimeter - Schematic
Figure 002

C. Electrical Diagram
(Ref. Fig. 003)

3. Standby Altimeter

A. Altimeter (in feet)
R (Ref. Fig. 004)
(Ref. Fig. 005)
The standby altimeter is contained in a 3 ATI-S case located on instrument panel 4VU. It is supplied with static pressure by the standby air data system by means of :
- a pointer (item 6) performing one revolution of the dial for 1000 feet.
- a display counter (item 2) made up of three drums displaying respectively the tens of thousands, thousands and hundreds of feet.

When the altitude is below 10,000 ft., the drum which indicates the tens of thousands of feet displays black and white stripes.
When the altitude is negative, the drum which indicates the tens of thousands of feet displays red and white stripes.
A knob (item 5) located at the lower LH side of the indicator enables display of the reference that is used for baro correction within the range of 745 to 1050 mb (22 to 31 in. Hg).
This correction is displayed on two counters (item 4), one graduated in millibars, the other in inches of mercury.
R An arc amber warning flag marked VIB comes into view in vibrator window
R (item 1) in the event of failure of the internal vibrator and when the air-
R craft is on ground. In that case, the data displayed is slightly downgraded.

B. Metric Altimeter
The metric altimeter is contained in a 2 ATI-S case, located on Captain's main instrument panel 3VU. It is supplied with static pressure by the standby air data system and displays altitude in meters.
(Ref. Fig. 006)
(Ref. Fig. 007)

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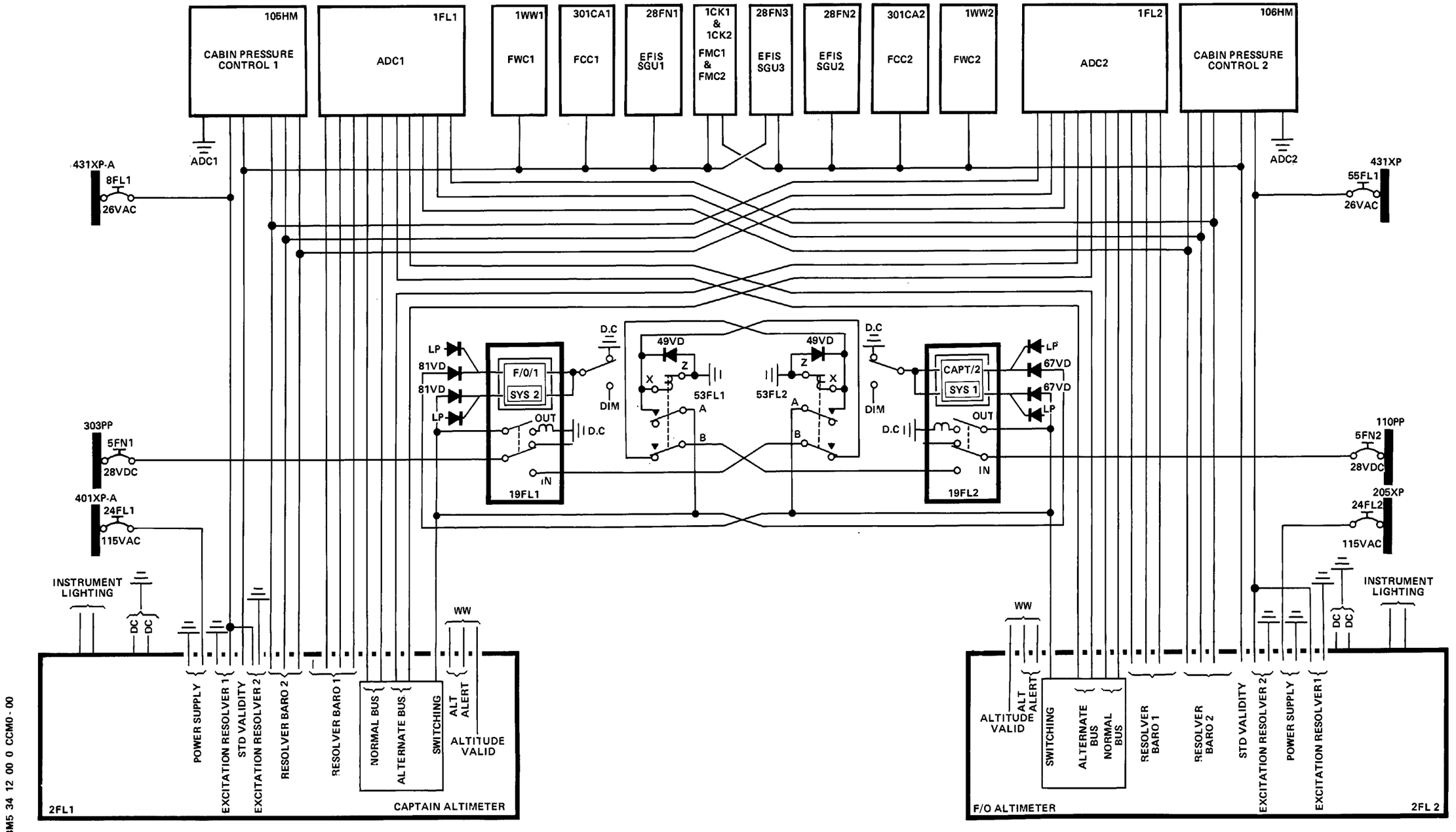
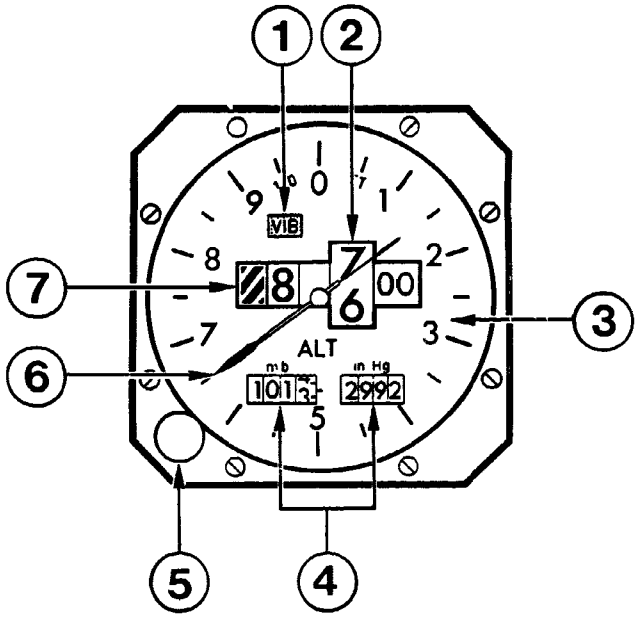


Altitude Information - Electrical Diagram - Normal Circuit
Figure 003



-1- VIBRATOR WINDOW. WHEN THE INSTRUMENT IS UTILIZED, THIS WINDOW IS BLANK. AN ARC AMBER VIB FLAG COMES INTO VIEW IN CASE OF VIBRATOR FAILURE, AND WHEN THE AIRCRAFT IS ON GROUND. THE INDICATOR CAN STILL BE USED, BUT THE ALTITUDE POINTER MOVEMENT WILL BE JERKY.

-2- ALTITUDE COUNTER
THE COUNTER DISPLAYS ALTITUDE READINGS UP TO 50.000 FT

-3- ALTITUDE DIAL
THE DIAL IS CALIBRATED FROM 0 TO 1000 FT.WITH 20 FT. GRADUATIONS.

-4- BARO SET COUNTERS
TWO COUNTERS, ONE FOR BAROMETRIC PRESSURE IN MILLIBARS AND THE OTHER IN INCHES OF MERCURY, DISPLAY PRESSURE SETTINGS CONTROLLED BY BARO SET KNOB.

-5- BARO SET KNOB
IT IS USED FOR SETTING PRESSURE READINGS ON THE BARO SET COUNTERS.

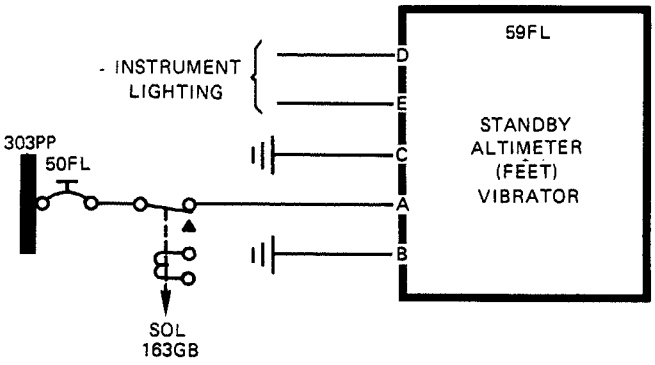
-6- ALTITUDE POINTER (WHITE)
THE POINTER INDICATES ALTITUDES BETWEEN 1000 FT. LEVELS.

-7- ALTITUDE COUNTER LEFT DRUM
A WHITE AND BLACK SHUTTER COVERS THE DRUM, IF ALTITUDE IS BELOW 10.000 FT.
IF ALTITUDE IS NEGATIVE, A RED AND WHITE STRIPED SHUTTER COVERS THE DRUM.

BM5 34 12 00 0 SCP0 01

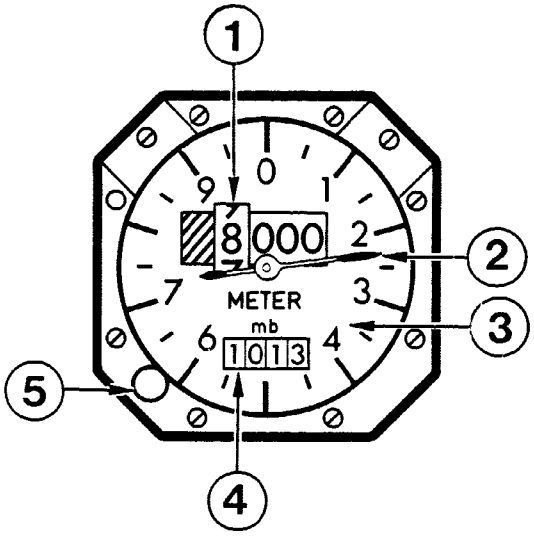
R

Standby Altimeter (in feet)
Figure 004



BM5 34 12 00 0 CD80 - 00

Standby Altimeter - Electrical Diagram
Figure 005



-1- DISPLAY COUNTER, MADE UP OF TWO DRUMS DISPLAYING RESPECTIVELY THE TENS OF THOUSANDS AND THE THOUSANDS OF METERS.
WHEN THE ALTITUDE IS BELOW 10.000 METERS, THE DRUM WHICH INDICATES THE TENS OF THOUSANDS OF METERS DISPLAYS BLACK AND WHITE STRIPES.
WHEN THE ALTITUDE IS NEGATIVE, THE DRUM WHICH INDICATES THE TENS OF THOUSANDS OF METERS DISPLAYS RED AND WHITE STRIPES.

-2- POINTER WHICH PERFORMS ONE REVOLUTION OF THE DIAL FOR 1000 METERS.

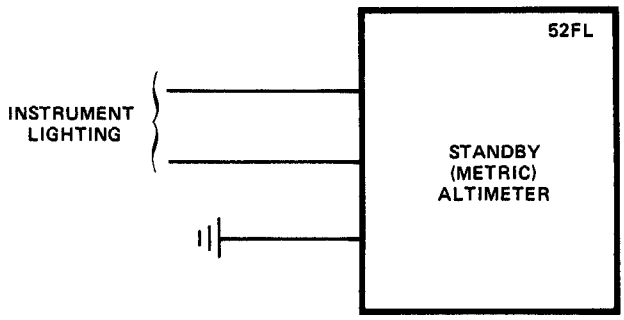
-3- ALTITUDE DIAL CALIBRATED FROM 0 TO 1000 METERS WITH 50 METERS GRADUATIONS.

-4- BAROMETRIC COUNTER, WHICH DISPLAYS BAROMETRIC CORRECTION.

-5- KNOB LOCATED AT THE LEFT LOWER PART OF THE INDICATOR, WHICH ENABLES THE DISPLAY OF THE REFERENCE FOR BAROMETRIC CORRECTION IN THE RANGE OF 870 TO 1050 MB.

BM5 34 12 00 0 SDMO

Metric Altimeter
Figure 006



BM5 34 12 00 0 CDP0.00

Metric Altimeter - Electrical Diagram
Figure 007

MAIN ALTIMETER (2FL1, 2FL2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-10-00, P. Block 501 (Ref. Fig. 401)	Flight Environment Data

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For Captain main altimeter

PANEL	SERVICE	IDENT.	LOCATION
22VU	ADS/CAPT/ALTM & VSI	24FL1	204/F18
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

(b)For First Officer main altimeter

PANEL	SERVICE	IDENT.	LOCATION
21VU	ADS/F/O/ALTM & VSI	24FL2	105/E11
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

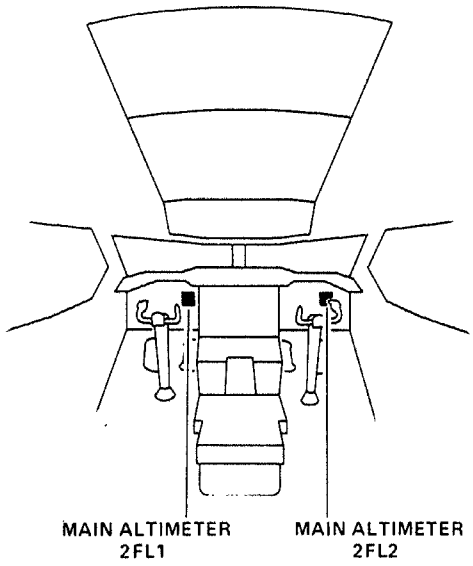
B. Removal

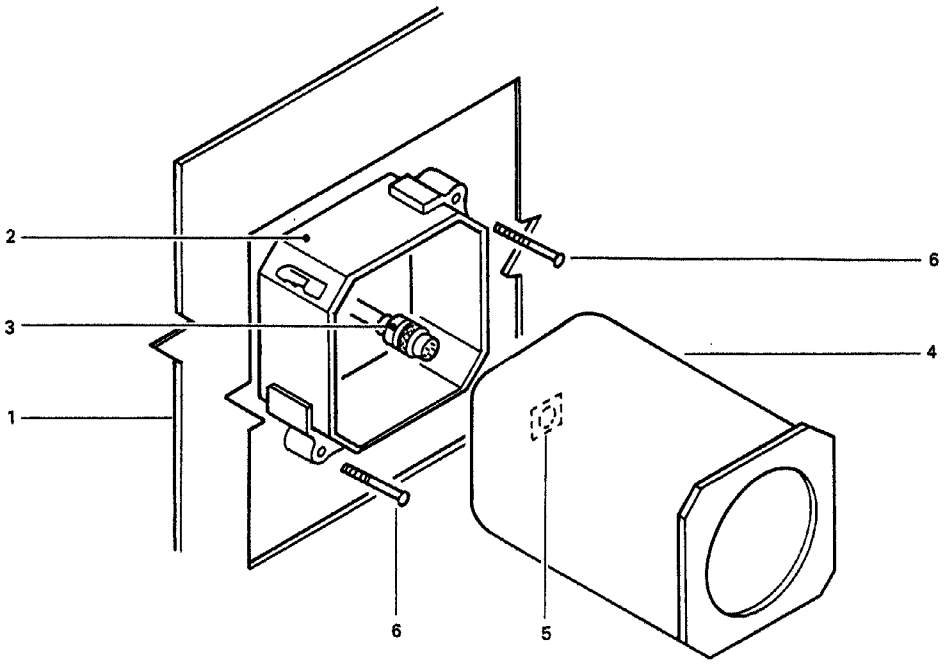
(1)Release the two screws (6) on clamp (2). Do not remove screws.
(2)Pull out altimeter (4).
(3)Disconnect and cap electrical connector (3).
(4)Cap electrical connector (5) on altimeter (4).
(5)Remove altimeter (4).

C. Installation

(1)Clean and inspect altimeter interface and/or adjacent area.
(2)Remove blanking caps from connectors (3) and (5).
(3)Connect electrical connector (3) to altimeter (4).
(4)Position altimeter (4) in clamp (2).
(5)Secure altimeter (4) to instrument panel (1) and tighten screws (6).
(6)Remove safety clips and tags and close the following circuit breakers :

(a)For Captain main altimeter : 24FL1 and 1LF.
(b)For First Officer main altimeter : 24FL2 and 1LF.





BM5 34 12 21 4 AAM2 00

Main Altimeter
Figure 401

D. Test
(1)Carry out BITE TEST of ADS1 (2) (Ref. 34-10-00, P. Block 501).
(2)Carry out a baro correction test of ADS1 (2) (Ref 34-10-00, P. Block 501).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedures	
- 33-13-00, P. Block 501	Instrument and Panel Integral Lighting
- 34-10-00, P. Block 501	Flight Environment Data

(Ref. Fig. 401)

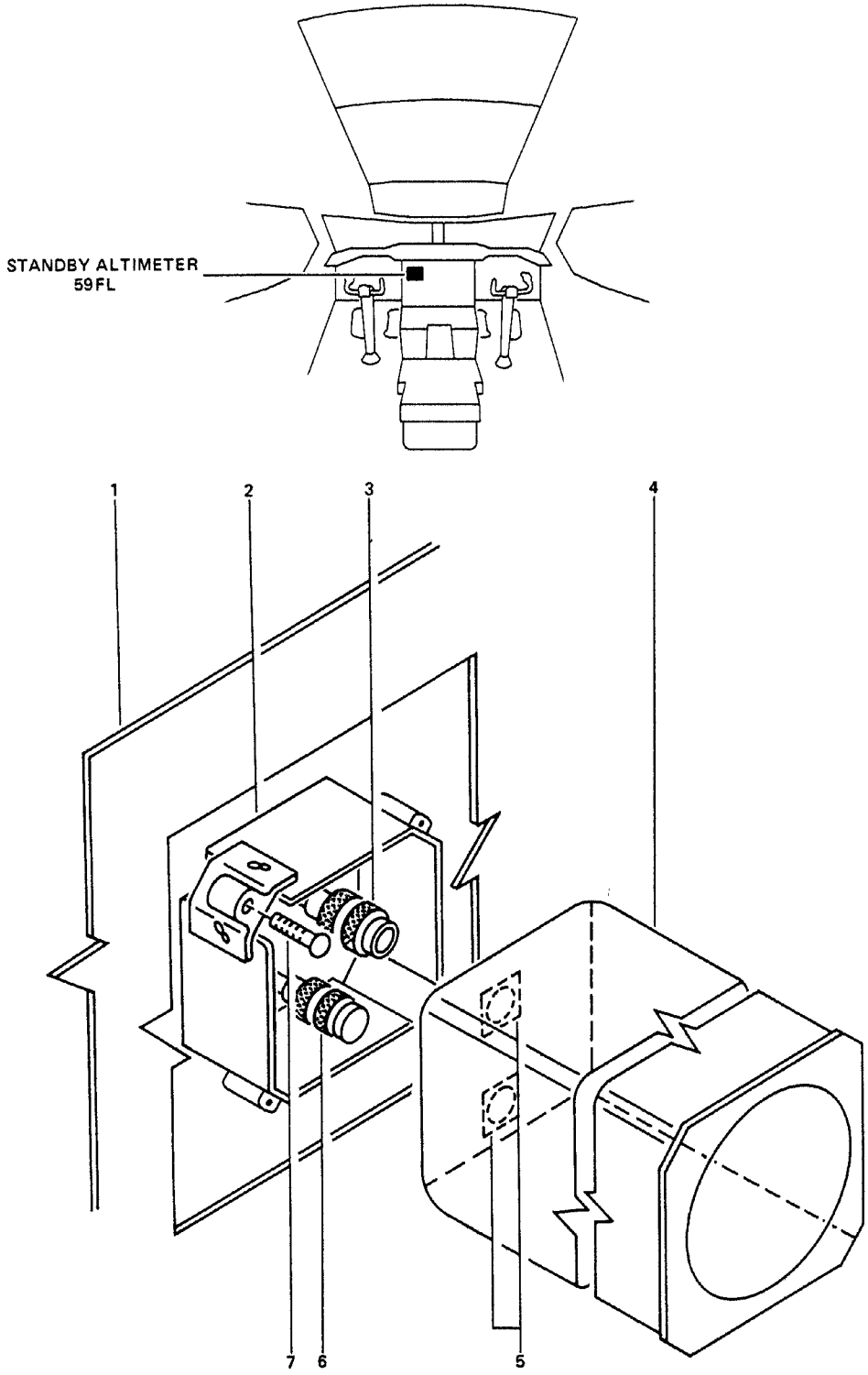
2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
22VU	ADS/STBY ALTM	50FL	204/F19
132VU	LIGHTING/INTEGRAL LT/MAIN PNL & GLARE SHLD	1LF	322/N76

B. Removal
(1)Release the two screws (7) on clamp (2). Do not remove screws.
(2)Pull out standby altimeter (4).
(3)Disconnect cap electrical connector (3) and air pressure line Quick-Attach-Detach (QAD) connector (6) from altimeter (4).
(4)Blank connectors (5) on altimeter (4).
(5)Remove altimeter (4).

C. Installation
(1)Clean and inspect altimeter interface and/or adjacent area.
(2)Remove blanking caps from connectors (3) and (6) and altimeter connectors (5).
(3)Connect electrical connectors (3) and air pressure line QAD connector (6) to appropriate altimeter (4) connectors.
NOTE : After the connection :
- make certain that a colored ring is shown on the QAD connector
- pull the connector to make certain that it is connected correctly.
(4)Position altimeter (4) in clamp (2).
(5)Secure altimeter (4) to instrument panel (1) and tighten screws (7).
(7)Remove safety clips and tags and close circuit breakers 50FL and 1LF.
D. Test
(1)Carry out integral lighting operational test (Ref. 33-13-00, P. Block 501).



Standby Altimeter
Figure 401

NOTE : You do not have to do a leak test when you connect a Quick-Attach-Detach (QAD) fitting.
A visual check of the QAD for a complete seal is necessary.
You must do a leak test of the Standby Static System (Ref. 34-10-00 P. Block 501) when you cannot make sure the QAD has a complete seal.

E. Close-Up

Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedures	
- 33-13-00, P. Block 501	Instrument and Panel Integral Lighting
- 34-10-00, P. Block 501	Flight Environment Data

(Ref. Fig. 401)

2. Procedure

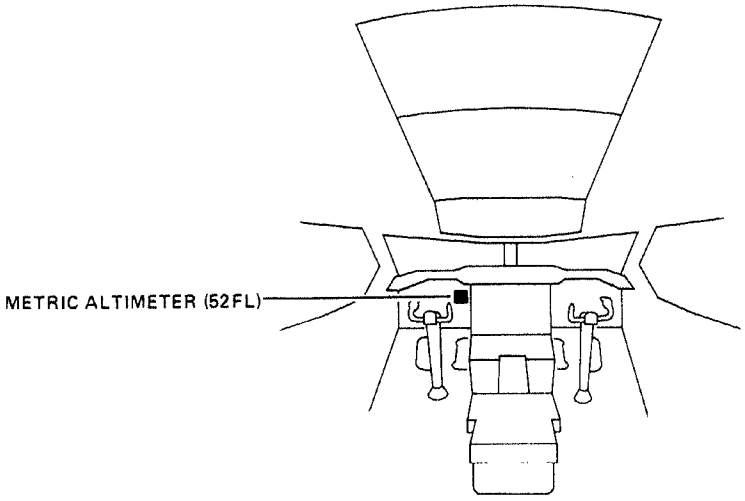
A. Job Set-Up
(1)Open, safety and tag the following circuit breaker :

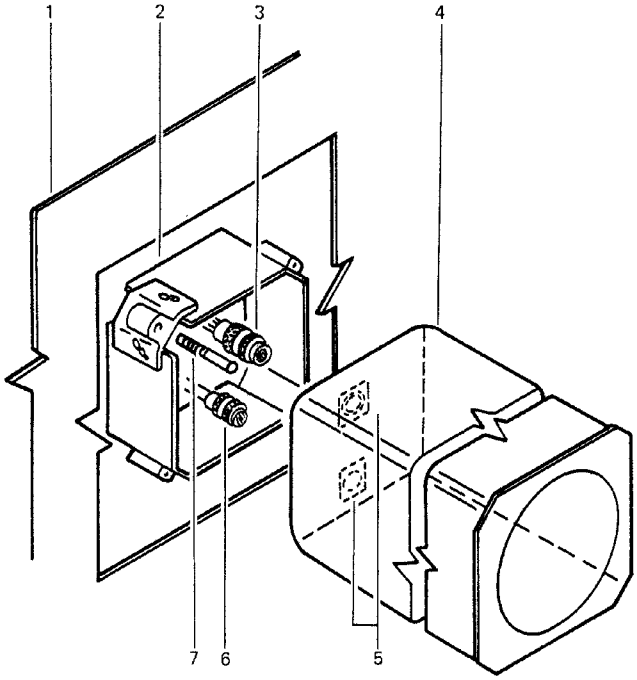
PANEL	SERVICE	IDENT.	LOCATION
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

B. Removal
(1)Release the two screws (7) on clamp (2). Do not remove screws.
(2)Open Captain instrument panel (1).
R (3)Disconnect cap electrical connector (3) and air pressure line
R Quick-Attach-Detach (QAD) connector (6) from altimeter (4).
(4)Blank connectors (5) on altimeter (4).
(5)Remove altimeter (4).

C. Installation
(1)Clean and inspect altimeter interface and/or adjacent area.
(2)Remove blanking caps from connectors (3) and (6) and from altimeter (4) connectors (5).
(3)Position altimeter (4) in clamp (2).
R (4)Connect electrical connectors (3) and air pressure line QAD connector (6)
R to appropriate altimeter (4) connectors.
R NOTE : After the connection :
R - make certain that a colored ring is shown on the QAD connector
R - pull the connector to make certain that it is connected
R correctly.
(5)Secure altimeter (4) to Captain instrument panel (1) and tighten screws (7).
(6)Close Captain instrument panel.
(8)Remove safety clip and tag and close circuit breaker 1LF

D. Test
(1)Carry out integral lighting operational test (Ref. 33-13-00, P. Block





BM5 34 12 25 4 AAM2 00

Metric Altimeter
Figure 401

501).

(2)Carry out operational test of standby instruments (Ref. 34-10-00, P. Block 501, Para. 1. C. Standby Instruments, Test).

R NOTE : You do not have to do a leak test when you connect a
R Quick-Attach-Detach (QAD) fitting unless both indicators are
R removed.
R A visual check of the QAD for a complete seal is necessary.
R You must do a leak test of the Standby Static System (Ref.
R 34-10-00 P. Block 501) when you cannot make sure the QAD has a
R complete seal.

E. Close-Up

Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

AIRSPEED - MACH - VMO - DESCRIPTION AND OPERATION

1. General

Computed airspeed Vc and Mach number are supplied to the normal systems by CRT main instruments : the Primary Flight Displays (PFD).
Two standby airspeed indicators adjacent to the PFDs display standby indicated airspeed.

2. Main Mach and Airspeed Data

(Ref. Fig. 001)
(Ref. Fig. 002)
(Ref. Fig. 003)

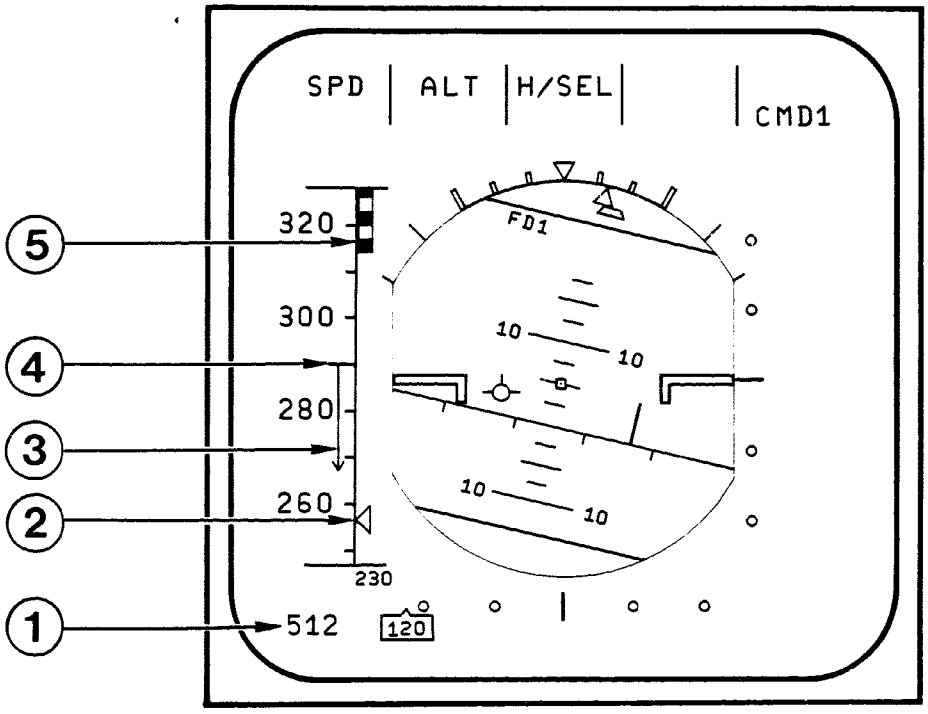
A. Display

The PFD displays the airspeed data computed by the ADC and processed by the associated symbol generator unit (SGU).
. a mobile vertical scale which moves past a fixed reference circle (Ref. Fig. 001) enables display of computed airspeed (item 4).
On the same scale, the following speed data is displayed :
- airspeed tendency (item 3) : a pointer indicates the airspeed which will be attained after 10 seconds (Ref. Fig. 001). Computed by the FAC.
- selected airspeed (item 2) (Ref. Fig. 001) : it is selected by the crew on the FCU, or through the associated FMC.
- Maximum Operating Airspeed (VMO, VFE), indicated by a red and black checkered tape (item 5) and computed by the FAC.
- Advisory airspeeds : flap (-F) or slat (-S) retraction airspeed, (item 3) (Ref. Fig. 002) and/or maneuvering airspeed (-M), (item 4) (Ref. Fig. 002). These airspeeds are computed by the FAC.
- Minimum selectable airspeed (item 2) (Ref. Fig. 002) computed by the FAC
- Stick shaker stall warning speed, (item 1) (Ref. Fig. 002), computed by the FAC.

The PFD displays Mach number data computed by the ADC and processed by the associated SGU. When Mach number is less than 0,5, this information is not displayed.
In the event of failure of airspeed and Mach data from ADC, the airspeed scale goes out of view and only a vertical red line marked SPD remains visible on the PFD screen.

B. Distribution of Vc and Mach Number data on the PFDs

(Ref. Fig. 004)
Bus No.2 from ADC1 normally supplies EFIS SGU1, which controls the Captain's PFD.
Bus No.2 from ADC2 normally supplies EFIS SGU2 which controls the First Officer's PFD.
In case of ADC failure, the SGU normally associated with the failed ADC can be connected to bus No.2 from the ADC in operation.
In case of failure of SGU1 or SGU2, either can be replaced by SGU3 after selection by the crew. The Captain has priority.
In these two cases of failure, selection is made through illuminated pushbutton switches located on panels 402VU and 406VU.



-1- MACH INDICATION (WHITE)
IT PROVIDES MACH NUMBER ABOVE 0.5 MACH. NO INDICATION IS PROVIDED BELOW THIS VALUE, EXCEPT THREE DASHED LINES.

-2- SELECTED AIRSPEED INDEX (CYAN)
THIS INDEX IS CONTROLLED BY THE FLIGHT CONTROL UNIT OR THE FLIGHT MANAGEMENT COMPUTER. WHEN THE SELECTED SPEED EXCEEDS THE AIRSPEED SCALE VALUE, THIS INFORMATION IS PRESENTED BY A THREE DIGIT NUMBER (CYAN) BELOW THE SCALE. THE INDEX AND/OR THE NUMBER FLASHES AMBER WHEN THE SELECTED AIRSPEED IS BELOW THE MINIMUM AIRSPEED.

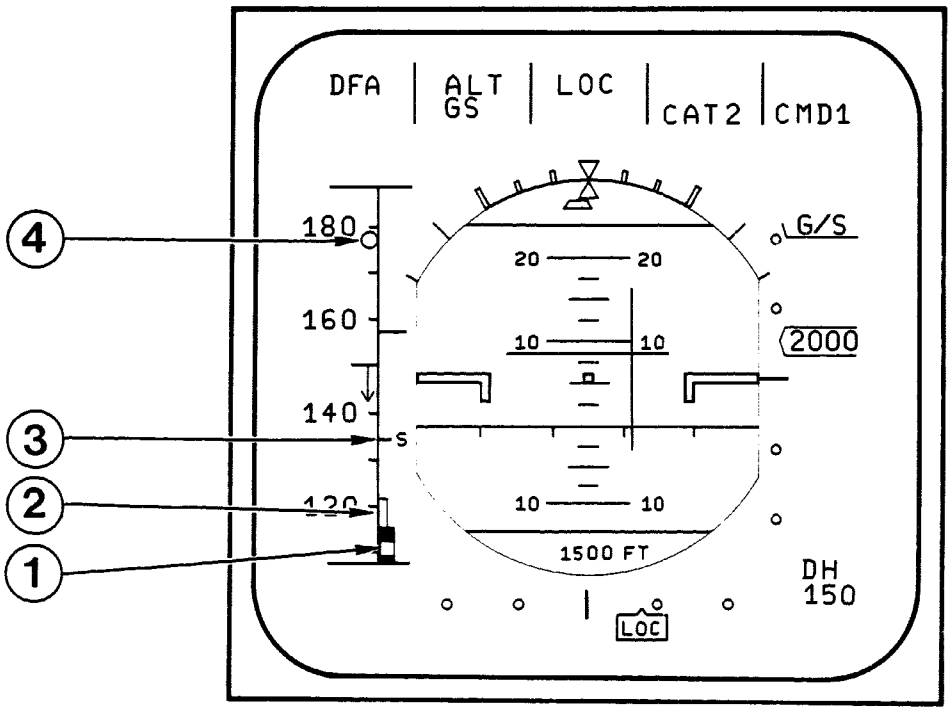
-3- AIRSPEED TENDENCY (YELLOW) :
THIS POINTER GIVES THE AIRSPEED VALUE WHICH WILL BE ATTAINED IN 10 SECONDS FROM THE PRESENT AIRSPEED.

-4- COMPUTED AIRSPEED (YELLOW) : THIS FIXED CIRCLE GIVES THE COMPUTED AIRSPEED, AND ALWAYS LIES IN THE CENTRE OF THE AIRSPEED SCALE.

-5- MAXIMUM OPERATING AIRSPEED RIBBON (RED AND BLACK) :
THIS RIBBON PROVIDES THE MAXIMUM OPERATING AIRSPEED AND IS CONTROLLED BY THE FLIGHT AUGMENTATION COMPUTER.

BM5 34 13 00 0 RAED

PFD - Mach and Airspeed Indications
Figure 001



-1- MINIMUM AIRSPEED TAPE (RED AND BLACK)
THIS TAPE IS CONTROLLED BY THE FLIGHT AUGMENTATION COMPUTER, WHICH IN TURN CONTROLS THE STICK SHAKER.

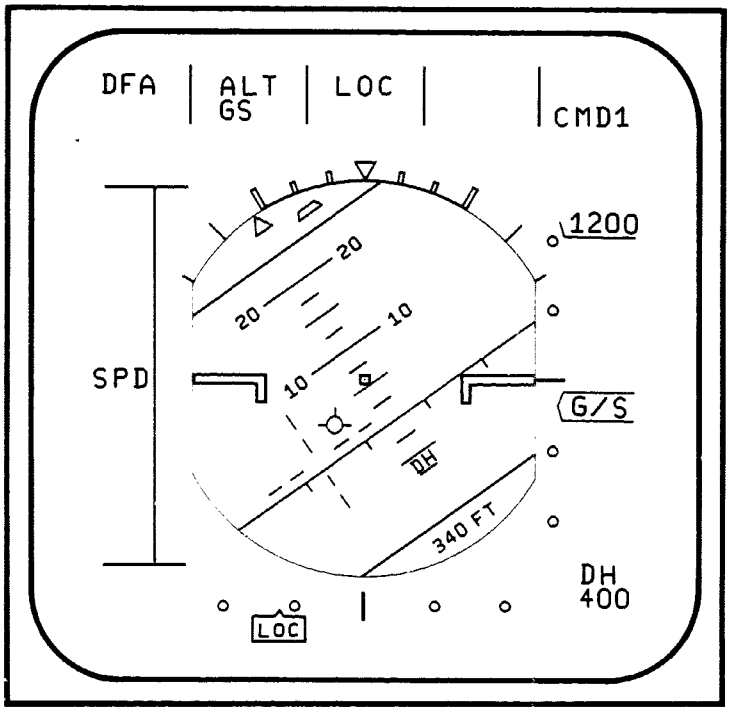
-2- MINIMUM SELECTABLE AIRSPEED STRIP (AMBER) :
THIS STRIP IS CONTROLLED BY THE FLIGHT AUGMENTATION COMPUTER, AND PROVIDES MINIMUM SELECTABLE AIRSPEED.

-3- ADVISORY AIRSPEEDS (CYAN) :
LETTERS (–F) AND (–S) AGAINST THE AIRSPEED SCALE, REPRESENT FLAP AND SLAT RETRACTION AIRSPEED, CONTROLLED BY THE FAC.

-4- ADVISORY AIRSPEED (CONTINUED) (CYAN)
THIS CIRCLE REPRESENTS THE MANEUVER AIRSPEED. THIS CIRCLE IS NOT DISPLAYED WHEN THE FLAPS ARE FULLY EXTENDED. THIS INFORMATION IS PROVIDED BY THE FAC.

BM5 34 13 00 0 RAPO

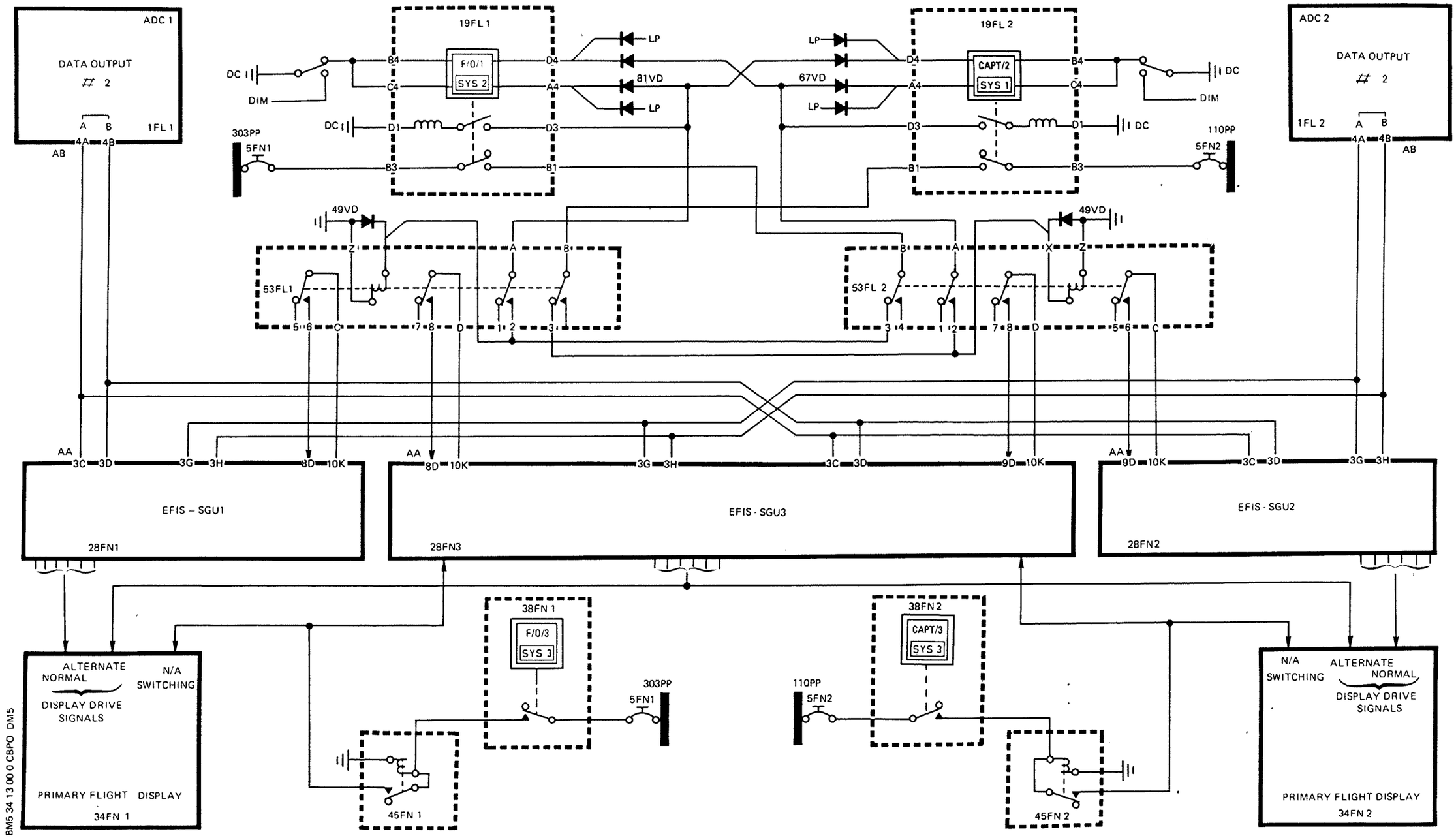
PFD - Computed Airspeed Displays
Figure 002



WHEN AN ADC AIRSPEED COMPUTATION FAILURE IS DETECTED, THE AIRSPEED SCALE DISAPPEARS, AND IS REPLACED BY A VERTICAL RED LINE WITHOUT GRADUATIONS.
A RED INSCRIPTION «SPD» REPLACES THE COMPUTED AIRSPEED INDICATION. IT FLASHES FOR THE FIRST THREE SECONDS AND THEREAFTER REMAINS STATIONARY.

BM5 34 13 00 0 RBBO

PFD - Computed Airspeed Failure
Figure 003



VC and Mach Data - Electrical Diagram - Normal Circuits
Figure 004

3. Standby Airspeed Indicator

(Ref. Fig. 005)

These are pressure operated instruments contained in 3-ATIS cases.

They are supplied with static and total pressure by the standby air data circuit.

One is installed on Captain's main instrument panel, the other on First Officer's main instrument panel.

They display airspeed data with the following accuracy :

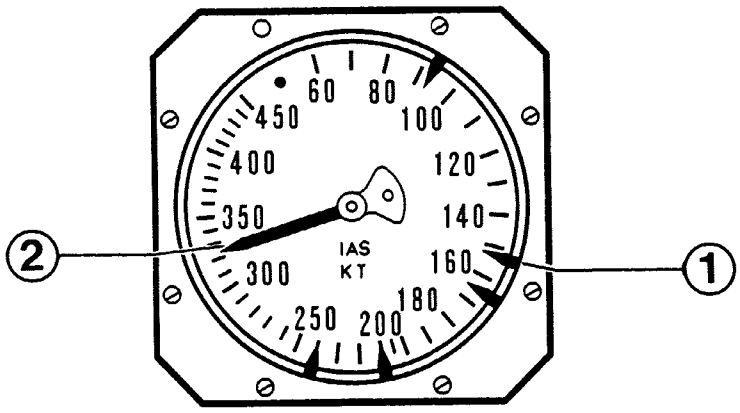
± 2 kts for Vc < 150 kts

± 3 kts for 150 < Vc < 250 kts

± 4 kts for 250 < Vc < 360 kts

by means of a pointer (item 2) (Ref. Fig. 005) which moves on a dial bearing a non-linear scale with spread out graduations between 60 and 450 kts.

Five manually operated external bugs (item 1) sliding on a ring enable a speed preselection.



-1- AIRSPEED BUGS :
FIVE MANUALLY ADJUSTABLE BUGS ARE PROVIDED FOR MANUAL SPEED SETTING.

-2- AIRSPEED POINTER
THE POINTER INDICATES AIRSPEED. WHEN THE AIRCRAFT IS ON THE GROUND, THE POINTER MOVES TO THE ZERO POSITION (MECHANICAL STOP BETWEEN 60 AND 450 KTS).

BM5 34 13 00 0 BRM0 01

Standby Airspeed Indicator
Figure 005

STANDBY AIRSPEED INDICATOR 60FL1 AND 60FL2 - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 33-13-00, P. Block 501	Instrument and Panel Integral Lighting

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breaker :

(a)For Captain and First Officer standby airspeed Indicators.

PANEL	SERVICE	IDENT.	LOCATION
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

B. Removal

(1)Loosen the two screws (7) on clamp (2). Do not remove screws.

(2)Pull out standby airspeed indicator (4).

(3)Disconnect cap electrical connector (3) and air pressure line
R Quick-Attach-Detach (QAD) connectors (6) from indicator (4).

(4)Blank connectors (5) on indicator.

(5)Remove indicator (4).

C. Installation

(1)Clean and inspect indicator interface and/or adjacent area.

(2)Remove blanking caps from connectors (3) and (6) and connectors (5) on indicator.

(3)Connect electrical connector (3) and air pressure line QAD connectors (6)
R to appropriate indicator (4) connectors.

NOTE : After the connection :
- make certain that a colored ring is shown on the QAD connectors
- pull the connectors to make certain that they are connected correctly.

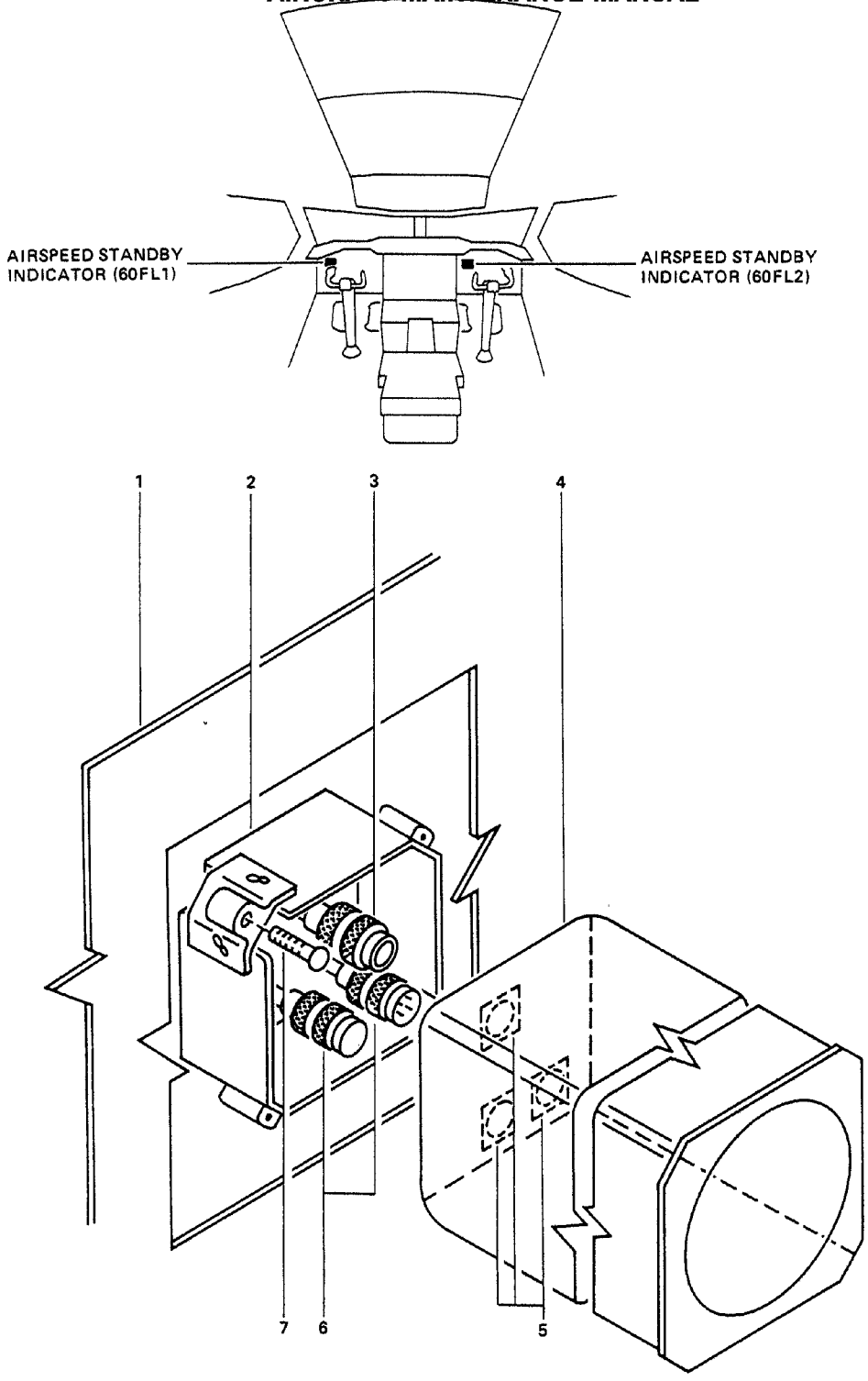
(4)Position indicator (4) in clamp (2).

(5)Secure indicator (4) to instrument panel (1) and tighten screws (7).

R (6)Close circuit breaker 1LF.

D. Test

NOTE : You do not have to do a leak test when you connect a Quick-Attach-Detach (QAD) fitting unless both indicators are removed. A visual examination of the QAD for a complete seal is necessary. You



BM5 34 13 22 4 AAM2 00

Standby Airspeed Indicator
Figure 401

must do a leak test when you cannot make sure the QAD has a complete seal.

(1) Carry out integral lighting operational test (Ref. 33-13-00, P. Block 501).

R

E. Close-Up

Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

VERTICAL SPEED - DESCRIPTION AND OPERATION

1. General

This information is supplied to the vertical speed indicators (VSI) by the IRS or ADCs, in digital format.
The Captain vertical speed indicator is normally supplied through data bus No.2 from IRS 1, and through data bus No.1 from ADC1 in case of anomaly. In case of emergency, it is supplied through data bus No.2 from ADC2.
The First Officer indicator is normally supplied through data bus No.2 from IRS2, and through data bus No.1 from ADC2 in case of anomaly. In case of emergency, it is supplied through data bus No.2 from ADC1.

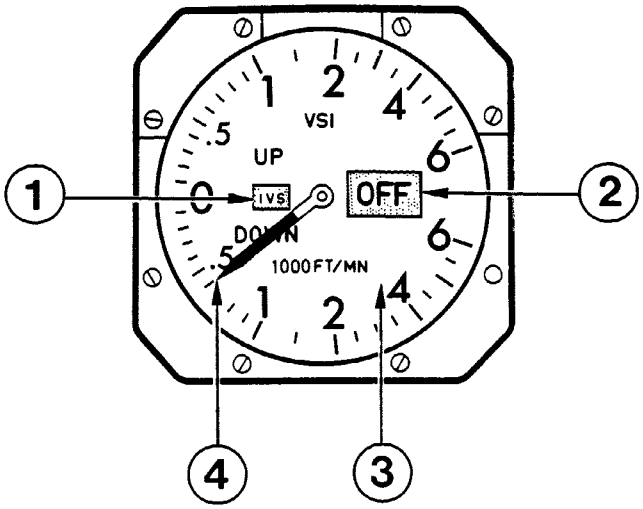
2. Vertical Speed Indicator

A. Description and Operation

(Ref. Fig. 001)
This indicator is contained in a 3ATI-S case
In normal operation, it repeats the inertial vertical speed data provided by the IRS by means of a pointer (item 4). This is an instantaneous indication.
If an anomaly is detected in the inertial vertical speed bus input message, the indicator is automatically switched over to ADC data bus. In that case, an arc yellow warning flag marked IVS comes into view on the face of the indicator.
In this mode of operation, the information is of the filtered type.
In case of operation from ADC data :
- monitoring of the messages transmitted by the inertial vertical speed bus goes on, so that if the anomaly disappears, the messages transmitted are received again after about one second. IVS flag then goes out of view.

A red failure warning flag (item 2) marked OFF comes into view when an error is detected in the message from the data bus selected, and the vertical speed pointer moves to zero.
This failure warning flag also comes into view, whatever the mode of operation
- when the indicator is not supplied
- when the monitoring system detects an internal failure.

The measuring range of the indicator is ± 6000 ft/mn. The scale has spread out graduations between 0 and ± 1000 ft/mn.
The display accuracy is ± 30 ft/mn or ± 2% (the greatest value).



-1- IVS FLAG (ARC YELLOW)
THIS FLAG COMES INTO VIEW WHEN THE INERTIAL VERTICAL SPEED FROM THE ALTITUDE SYSTEM, POWER SUPPLY OR INDICATOR IS FAULTY.

-2- OFF FLAG (RED)
THIS FLAG IS IN VIEW WHEN THE ALTITUDE RATES FROM BOTH ADCS ARE INVALID OR ABSENT. IT ALSO IS IN VIEW IN THE EVENT OF A POWER OR INDICATOR FAILURE.

-3- VERTICAL SPEED DIAL
THE DIAL IS GRADUATED TO 6000 FT/MIN UP AND DOWN, WITH SPREAD OUT GRADUATIONS BETWEEN 0 AND ±1000 FT/MIN.

-4- VERTICAL SPEED POINTER (WHITE)
THE POINTER MOVES ON THE DIAL. IN THE ABSENCE OF VERTICAL SPEED VALID SIGNALS, THE POINTER IS POSITIONED AT ZERO.

BM5 34 14 00 0 SAED

Vertical Speed Indicator
Figure 001

B. Principle of Operation

The following figure shows the internal diagram of the vertical speed indicator.

(Ref. Fig. 002)

(1)Input Data

The indicator receives vertical speed data from three different sources :

- an inertial reference system (IRS) transmitting inertial vertical speed data to a high speed bus (normal system).
- an ADC transmitting air data vertical speed (altitude rate) to a low speed bus (system which is automatically switched over in case of IRS failure).
- a second ADC transmitting air data vertical speed information to a low speed bus (used as a standby system when manually switched over).

ARINC specification 429 inertial vertical speed (label 365) or air data vertical speed (label 212) digital data from IRS or ADC is received on input data busses. The signals are adapted and shaped so as to be received by the LSI reception circuit the function of which is to ensure reception interface with the microprocessor of the processing unit.

The vertical speed value is converted into an input angular value equivalent to the electrical angle of a dummy resolver having the same scale factor as the output bootstrap resolver.

This angular value is converted into sine and cosine digital values.

(2)Boostrap Data (Output)

A resolver reproduces the mechanical output of the vertical speed display. The output electrical signals are generated from 400 Hz alternating voltage; they represent, in amplitude and phase, the sine and cosine of the bootstrap angle.

These voltages are multiplexed, sampled and converted into digital values by an analog/digital conversion channel.

(3)Computation of Angular Error

The input sine/cosine digital angular values are compared with the output (bootstrap) sine/cosine digital angular values. The error signal which is thus determined enables motor control order.

This order is converted into a continuous signal by the digital/analog converter and applied to the servomotor through a control circuit.

The servomotor drives the analog display pointer and the bootstrap resolver until the error signal is cancelled. Then the output signal is equal to the input signal.

An arc yellow warning flag marked IVS comes into view when air data vertical speed is displayed.

(4)Bus Switching

ADC INST pushbutton switches, located on LH and RH instrument panels 402VU and 406VU, enable switching of Captain's VSI to ADC2 and First Officer's VSI to ADC1.

C. Electrical Diagram

(Ref. Fig. 003)

INTENTIONALLY BLANK

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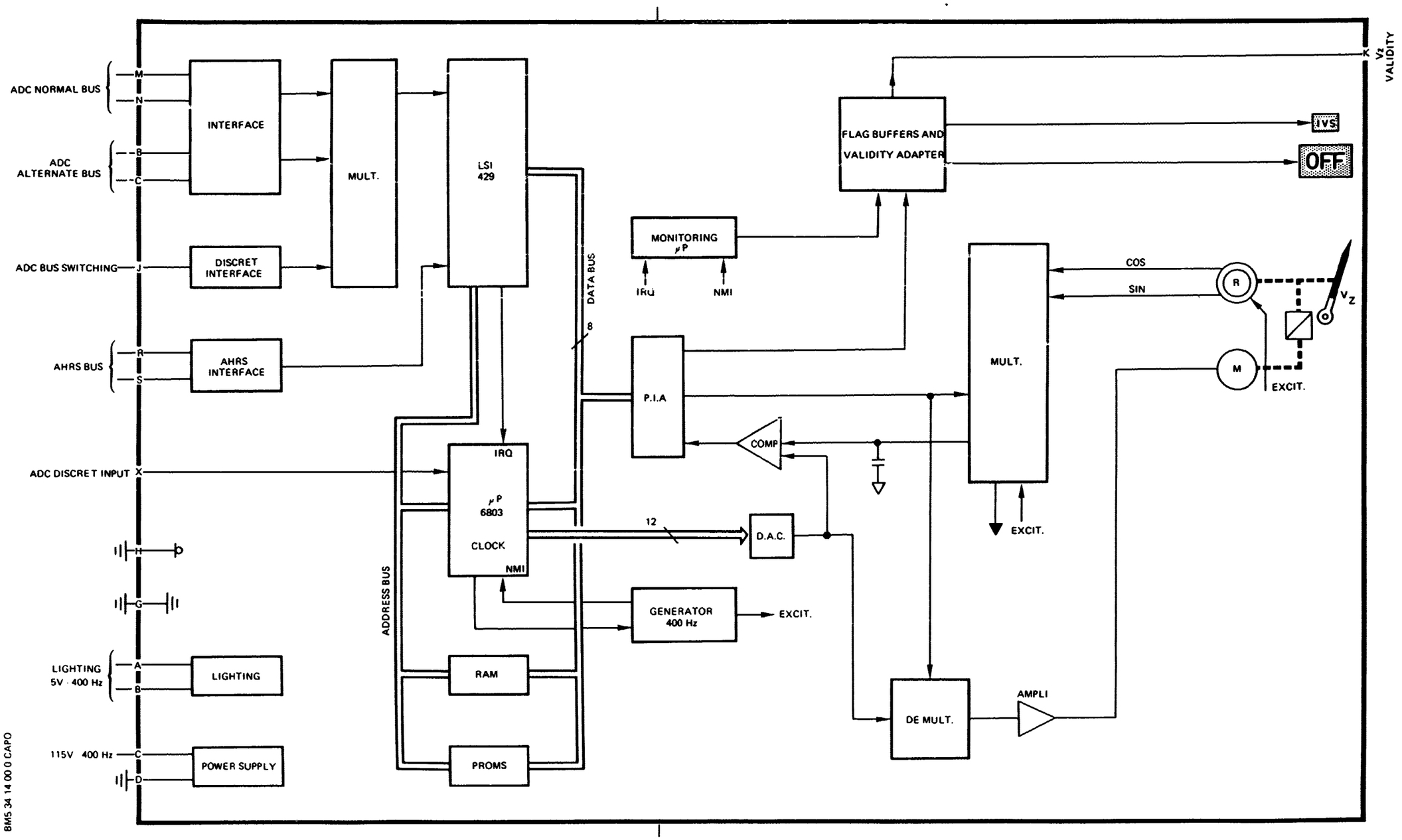

VSI - Schematic
Figure 002

EFFECTIVITY: 001-003,

PIA

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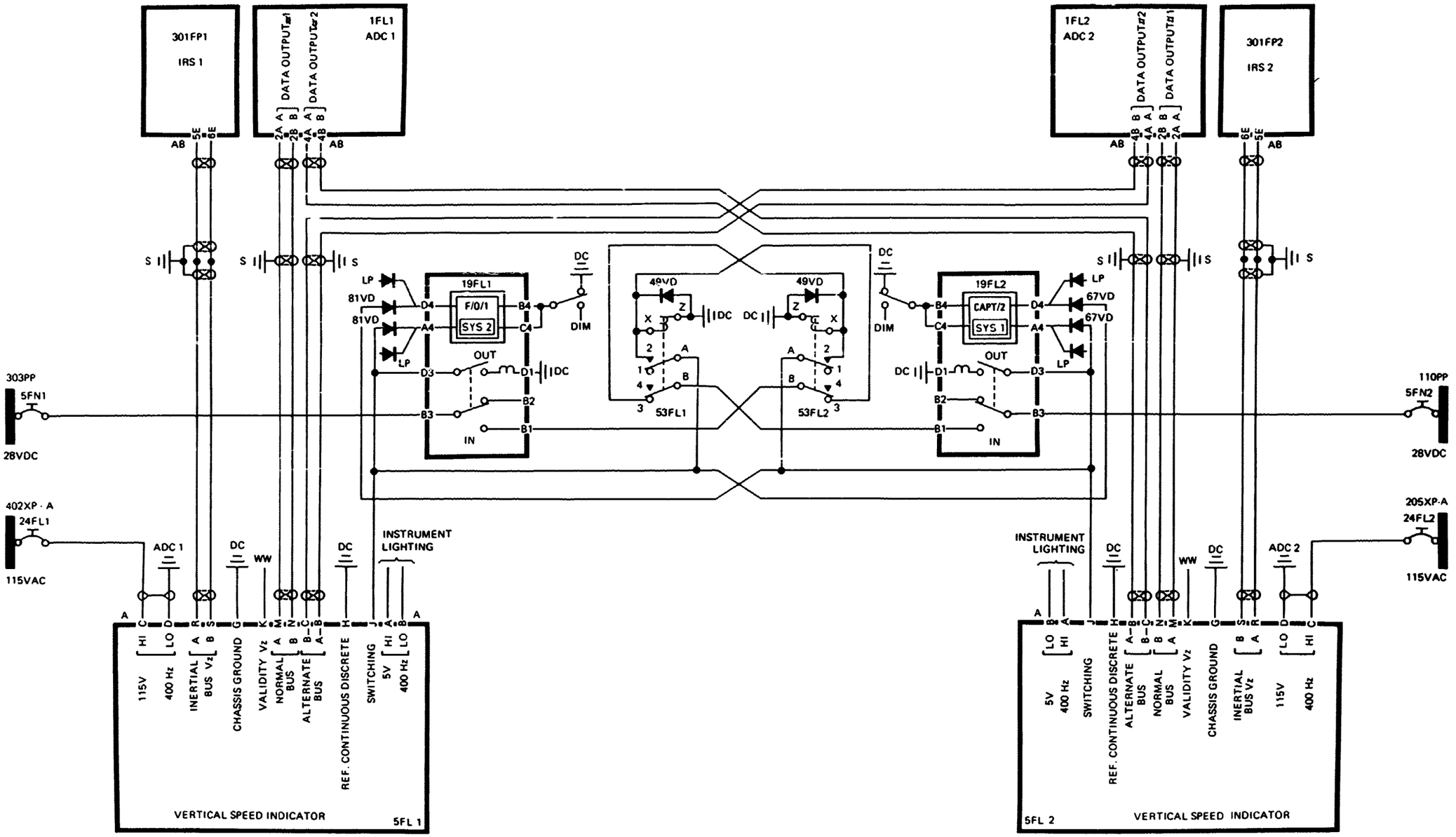


BM5 34 14 00 0 C88O

Vertical Speed Indicator - Electrical Diagram
Figure 003

EFFECTIVITY: 001-003,

PIA

Printed in France

VERTICAL SPEED INDICATOR/TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM INDICATOR - DESCRIPTION AND OPERATION

1. General

A. Vertical Speed Information

This information is supplied to Captain and First Officer VSI/TCAS indicators by the IRS or ADCs, in digital format.
Captain indicator is normally supplied through data bus No. 2 from IRS1, and through data bus No. 1 from ADC1 in case of anomaly. In case of emergency, it is supplied through data bus No. 2 from ADC2.
First Officer indicator is normally supplied through data bus No. 2 from IRS2, and through data bus No. 1 from ADC2 in case of anomaly. In case of emergency, it is supplied through data bus No. 2 from ADC1.

B. Traffic Advisory and Resolution Advisory Information

The digital VSI/TCAS indicators display the traffic all around the own aircraft by means of different symbols with the corresponding distance and bearing. This is the Traffic Advisory (TA) function.
If an intruder becomes threatening, the indicators indicate whether to climb, to descend or to remain level by lighting two attached arcs : a green and a red one.
The required vertical maneuver keeps the pointer out of the red arc and into the green arc. This is the Resolution Advisory function.
This information is supplied by TCAS data bus.

2. VSI/TCAS Indicator

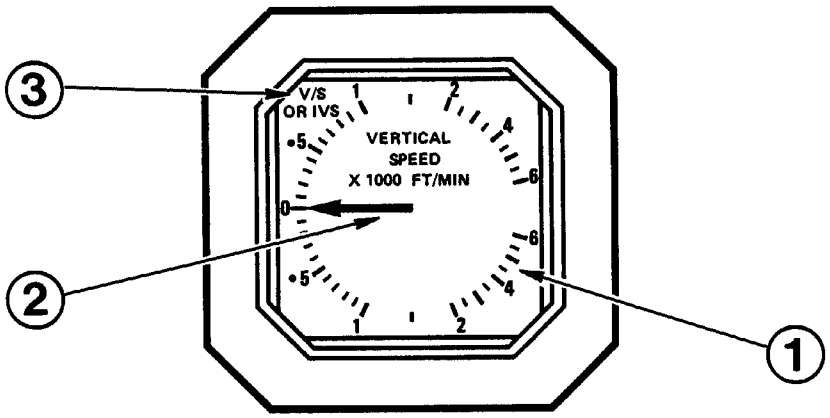
A. Description and Operation

(Ref. Fig. 001)
(Ref. Fig. 002)

R **ON A/C 101-200,

This indicator is contained in a 3 ATI-S case. Capt (F/O) indicator is located on LH (RH) main instrument panel 3VU (5VU) and equipped with a liquid cristal display.

(1) In normal operation, it repeats the inertial vertical speed data provided by the IRS by means of a pointer (item 2). This is an instantaneous indication.
If an anomaly is detected in the inertial vertical speed bus input message, the indicator is automatically switched over to ADC data bus. In that case, a yellow warning flag marked IVS comes into view on the upper corner on the face (item 3) of the indicator. In this mode of operation, the information is of the filtered type, and the monitoring of the messages transmitted by the inertial vertical speed bus goes on, so that if the anomaly disappears, the messages transmitted are received again after about one second : IVS flag, then, goes out of view. If an error is detected in the message from the ADC data bus from the same side as the concerned VSI, a yellow warning flag marked V/S comes into view.



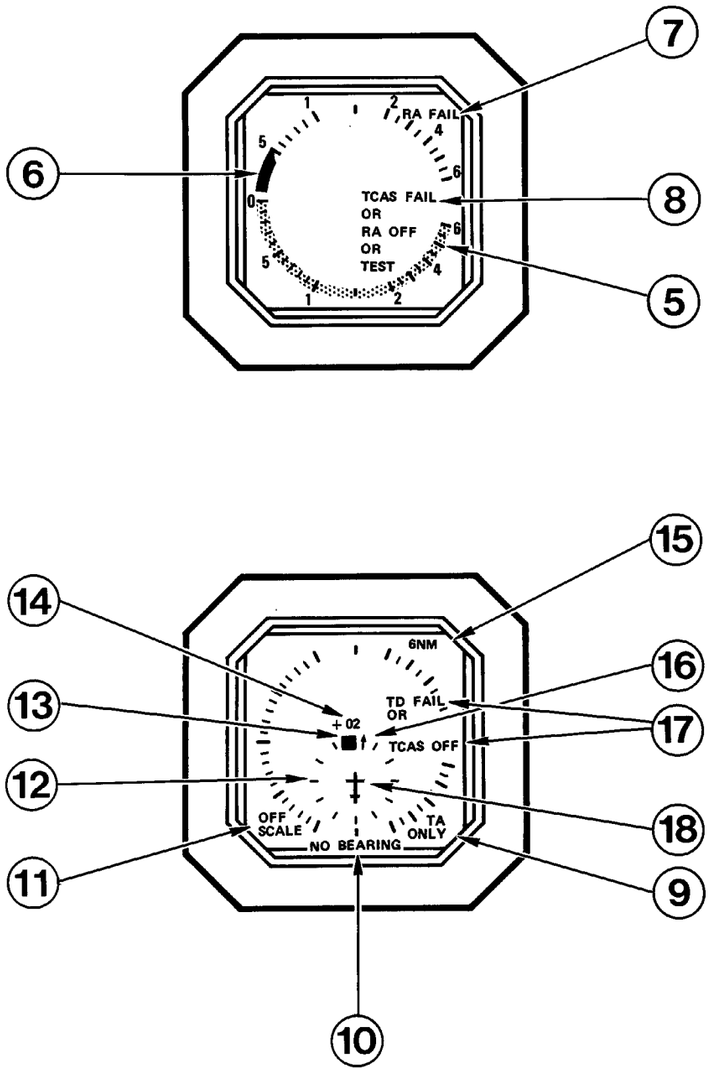
-1- VERTICAL SPEED DIAL
THE DIGITAL DIAL IS GRADUATED TO 6.000 FT/MIN UP AND DOWN, WITH SPREAD OUT GRADUATIONS BETWEEN 0 AND ± 1,000 FT/MIN.

-2- VERTICAL SPEED POINTER
THE POINTER MOVES ON THE DIAL IN THE ABSENCE OF VERTICAL SPEED VALID SIGNALS, THE POINTER IS POSITIONED AT ZERO.

-3- V/S (RED) OR IVS FLAG (YELLOW)
- IVS FLAG COMES INTO VIEW WHEN THE INERTIAL VERTICAL SPEED, POWER SUPPLY OR INDICATOR IS FAULTY.
- V/S FLAG COMES INTO VIEW WHEN VERTICAL SPEED FROM ADC SOURCE AND IRS SOURCE IS FAULTY.

BM5 34 14 00 0 SBH0 00

VSI/TCAS Indicator - Vertical Speed Function
Figure 001



VSI/TCAS Indicator - TA/RA Function
Figure 002

RESOLUTION ADVISORY FUNCTION

5. RED ARC LOCATED ALONG THE VERTICAL SPEED SCALE AND USED TO DISPLAY PROHIBITED VERTICAL SPEEDS.
6. "FLY TO" GREEN ARC ATTACHED TO THE RED ARC FOR CORRECTIVE ADVISORIES.
7. RA FAIL FLAG 1
8. TCAS FAIL FLAG OR RA OFF FLAG OR TEST FLAG.

TRAFFIC FUNCTION
FIXED SYMBOLOGY

12. RANGE RING. THE CENTER OF EACH OF THE TWELVE CLOCKWISE MARKS IS LOCATED ON THE CIRCLE WITH A RADIUS OF 2MM FOR THE BASIC CONFIGURATION.
15. SELECTED RANGE DISPLAY
18. OWN AIRCRAFT SYMBOL. THE INTERSECTION OF THE VERTICAL LINE AND UPPER HORIZONTAL LINE GIVES THE REFERENCE POINT FOR THE DISTANCES DISPLAYED (6MM AT THE FRONT AND 2.5MM AT THE BACK FOR THE BASIC CONFIGURATION).

INTRUDER SYMBOLOGY

9. TA ONLY MESSAGE. THIS MESSAGE IS CONTINUOUSLY DISPLAYED IF THE TCAS COMPUTER IS IN A SPECIAL OPERATING MODE. THE MESSAGE IS DISPLAYED IN BLACK LETTERS ON A WHITE BACKGROUND IN NORMAL OPERATION AND A YELLOW BACKGROUND IN THE PRESENCE OF AT LEAST ONE TA.
10. "NO BEARING" INTRUDER. THE POSITIONING OF THE SYMBOL (TA AND RA SYMBOLS ONLY) IS NOT POSSIBLE BUT IS REPLACED BY A "NO BEARING" MESSAGE.
EXAMPLE : TA 15.0 + 41.
11. OFF SCALE MESSAGE. THE RA OR TA INTRUDER IS OUTSIDE THE DISPLAY RANGE SCALE.
13. SYMBOL FOR DISPLAYING AN INTRUDER. ITS POSITION IN RELATION TO THE CENTER OF THE OWN AIRCRAFT SYMBOL GIVES ITS DISTANCE AND BEARING. FOUR SYMBOLS ARE USED TO IDENTIFY THE TYPE OF INTRUDER.

■ RESOLUTION ADVISORY (RA) SYMBOL (RED FILLED SQUARE.). ● TRAFFIC ADVISORY (TA) SYMBOL (YELLOW FILLED CIRCLE).

♦ PROXIMATE TRAFFIC SYMBOL (CYAN FILLED DIAMOND) ◊ NO THREAT (OTHER) SYMBOL (CYAN DIAMOND OUTLINED)

14. TAG INDICATES ALTITUDE. THE DISPLAY IS AS FOLLOWS : RELATIVE ALTITUDE (TWO SIGNED DIGITS), ACTUAL ALTITUDE (THREE DIGITS). CO-ALTITUDE (TWO UNSIGNED ZEROS). THE UNIT IS HUNDREDS OF FEET.
16. VERTICAL DIRECTION ARROW INDICATES THE RELATIVE VERTICAL SPEED OF THE INTRUDER. THE DISPLAY IS AS FOLLOWS : NO VERTICAL RATE (NO ARROW), CLIMBING (ARROW POINTS UPWARDS), DESCENDING (ARROW POINTS DOWNWARDS).
17. TD FAIL FLAG (FAILURE IN THE TRAFFIC FUNCTION ONLY) OR TCAS OFF MESSAGE (TCAS COMPUTER IS IN A SPECIAL OPERATING MODE).

When the indicator is switched over to the ADC data bus from the opposite side of the concerned VSI, through ADC INST pushbutton switch, IVS flag disappears. If an anomaly is detected on alternate ADC data bus, a yellow warning flag marked V/S appears ; and the vertical speed pointer disappears.
V/S flag comes also into view, whatever the mode of operation :
- when the indicator is not supplied
- when the monitoring system detects an internal failure.
The display accuracy is ± 30 ft/mn or ± 2 % (the greatest value).

(2)The second function of the VSI/TCAS indicators is to display :
- Traffic Advisory (TA) by means of a fixed symbology (own aircraft and dial) (items 12 and 18) and a moving symbology representing the intruders (item 13) with altitude (item 14), bearing (items 10 and 13), vertical speed tendency (item 16) and threat level (item 13).
- Resolution Advisory (RA) by lighting a green arc (item 6) for authorized vertical speeds and an attached red arc (item 5) for prohibited vertical speeds.

B. Principle of Operation

R **ON A/C 004-100,

This indicator is contained in a 3 ATI-S case. Capt (F/O) indicator is located on LH (RH) main instrument panel 3VU (5VU) and equipped with a liquid crystal display.

(1)In normal operation, it repeats the inertial vertical speed data provided by the IRS by means of a pointer (item 2). This is an instantaneous indication.
If an anomaly is detected in the inertial vertical speed bus input message, the indicator is automatically switched over to ADC data bus. In that case, a yellow warning flag marked IVS comes into view on the upper corner on the face (item 3) of the indicator. In this mode of operation, the information is of the filtered type, and the monitoring of the messages transmitted by the inertial vertical speed bus goes on, so that if the anomaly disappears, the messages transmitted are received again after about one second : IVS flag, then, goes out of view. If an error is detected in the message from the ADC data bus selected from the same side as the concerned VSI, a red warning flag marked V/S comes into view.
When the indicator is switched over to the ADC data bus from the opposite side of the concerned VSI, through ADC INST pushbutton switch, IVS flag disappears. If an anomaly is detected on alternate ADC data bus, a red warning flag marked V/S appears ; and the vertical speed pointer disappears.
V/S flag comes also into view, whatever the mode of operation :
- when the indicator is not supplied
- when the monitoring system detects an internal failure.
The display accuracy is ± 30 ft/mn or ± 2 % (the greatest value).

(2)The second function of the VSI/TCAS indicators is to display :
- Traffic Advisory (TA) by means of a fixed symbology (own aircraft and dial) (items 12 and 18) and a moving symbology representing the

intruders (item 13) with altitude (item 14), bearing (items 10 and 13), vertical speed tendency (item 16) and threat level (item 13).
- Resolution Advisory (RA) by lighting a green arc (item 6) for authorized vertical speeds and an attached red arc (item 5) for prohibited vertical speeds.

B. Principle of Operation

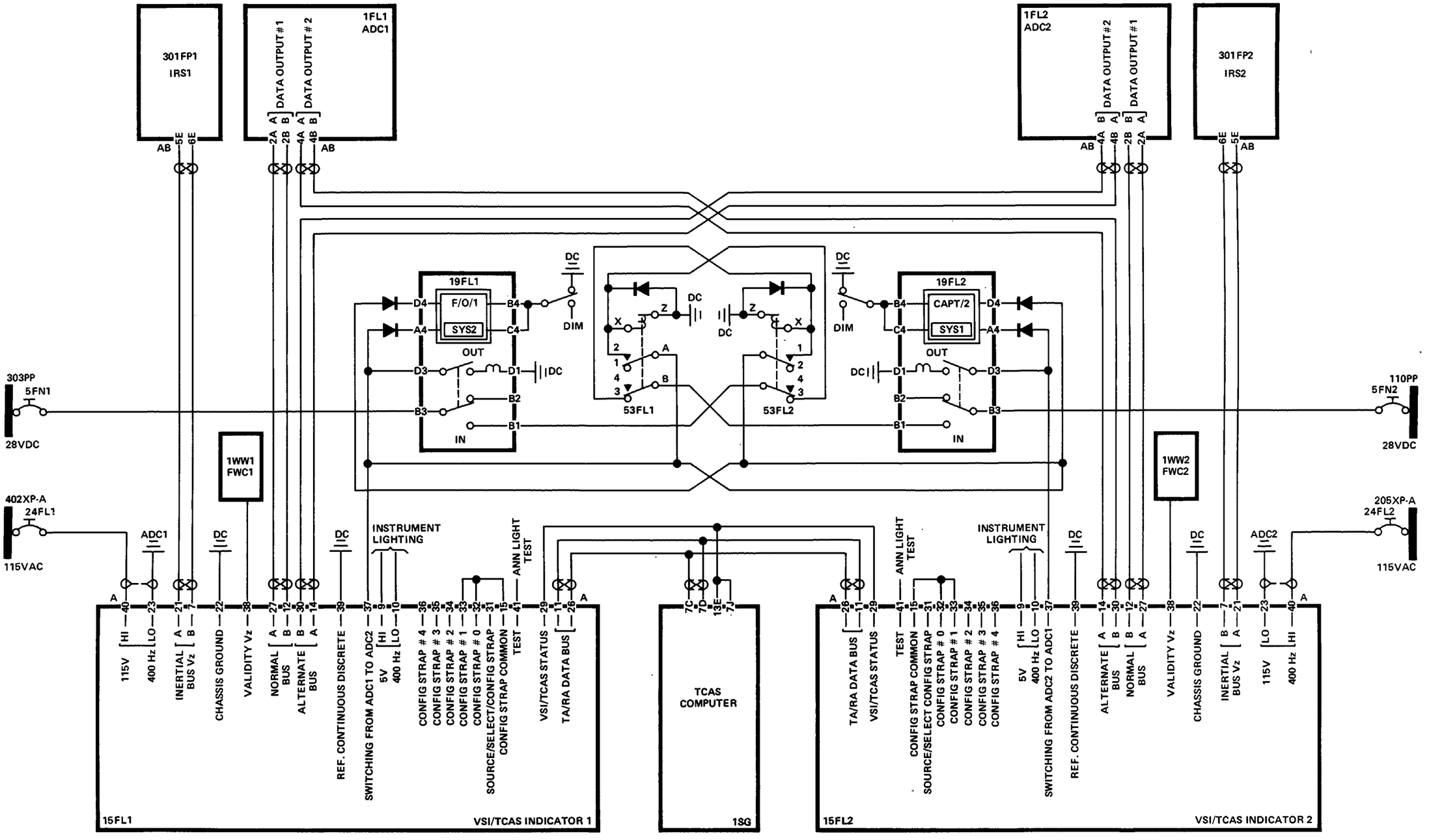
R **ON A/C 004-200,

(Ref. Fig. 003)
(1)Capt (F/O) indicator receives vertical speed data from three different sources :
- inertial reference system IRS1 (2) transmitting inertial vertical speed data to a high speed bus (normal system)
- air data computer ADC1 (2) transmitting air data vertical speed (altitude rate) to a low speed bus (system which is automatically switched over in case of IRS failure)
- a second air data computer ADC2 (1) transmitting air data vertical speed (altitude rate) to a low speed bus (used as a standby system when manually switched over)

ADC INST pushbutton switches, located on LH (RH) instrument panel 402VU (406VU), enable switching of Captain's VSI to ADC2 (First Officer's VSI to ADC1).

ARINC specification 429 inertial vertical speed (label 365) and air data vertical speed (label 212) digital data from IRS1 (2), ADC1 (2) and ADC2 (1) are received on input data busses of CAPT (F/O) indicator. These signals are processed so that present vertical speed is displayed on the dial by the pointer.

(2)Each indicator receives Traffic Advisory data (labels 130, 131 and 132) and Resolution Advisory data (label 270) from Traffic Alert and Collision Avoidance System (TCAS computer) by an high speed bus.
This data is processed, then sent to a symbol generator. Intruders are displayed by means of different symbols following their threat level, and are positioned on the dial following their bearing relative to own aircraft. Altitude is displayed in three digits : first one for the sign : + (above) or - (under), the other two represent the difference of altitude with own aircraft. A vertical arrow pointed upwards indicates that the intruder climbs and one pointed downwards that it descends.
If the intruder becomes threatening, a resolution advisory is received and processed in order to display "Fly to" vertical speeds with a green arc and prohibited vertical speeds with a red arc.
A flag generator can display different messages :
- TCAS FAIL : TCAS computer failure
- RA OFF : RA mode not selected
- TEST : when ATC - TCAS pushbutton switch is pressed on maintenance panel 470VU
- RA FAIL : no computed RA, invalid RA or V/S flag apparent
- TD FAIL : Traffic Display failure
- TCAS OFF : STANDBY mode selected
- TA ONLY : . white background if no intruder is detected



BM5 34 14 00 0 CCB0 00

VSI/TCAS Indicator - Schematic
Figure 003

R EFFECTIVITY: 004-200,

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. yellow background if an intruder is detected
- **NO BEARING** : when the bearing of the intruder is not known
- **OFF SCALE** : the intruder is outside the display range scale
- **XNM** : selected range display.

1. Operational Test

A. Bite Test

(1)Reason for the job

To check VZ function with IRS OFF using ADS bite facilities.

(2)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Make certain that overhead panel circuit breakers are closed, particularly ADS ones (panel 21VU, line 105; panel 22VU, line 204).

4 Make certain that ADC INST switching is in normal position.

5 Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (aircraft in ground configuration) on lines 331 and 332.

6 Make certain that AFS is not energized, PITCH TRIM and YAW DAMPER levers not engaged.

7 On overhead panel, check that MSU1(2) mode selector switch is in OFF position.

**ON A/C 001-003,

8 On CAPT (F/O) VSI, make certain that IVS flag is in view.

R **ON A/C 004-200,

8 On CAPT (F/O) VSI/TCAS, make certain that IVS flag is in view.

**ON A/C ALL

NOTE : The following test is valid for Captain system, for F/O system read information in parentheses.

(b)Test

NOTE : Disregard all annunciators and warnings processed during the ADS test other than related to the BARO vertical speed.

ACTION	RESULT
On maintenance panel 47OVU 1. Press ADS/SYS1(2) pushbutton switch	Check that : - On maintenance panel 47OVU

ACTION	RESULT
	. ADS/SYS1(2) TEST legend is on
**ON A/C 001-003,	
	Check on CAPT (F/O) VSI that : - for the first 5 s the OFF flag comes into view - for the next 5 s the OFF flag goes out of view, then, VSI pointer goes to 600 ft. per min position, then moves to 0 (zero) position.
R **ON A/C 004-200,	
	Check on CAPT (F/O) VSI/TCAS that : - for the first 5 s V/S flag comes into view - for the next 5 s V/S flag goes out of view, then VSI pointer goes to 600 ft. per min position, then moves to 0 (zero) position.
**ON A/C ALL	

2. Release ADS/SYS1(2) pushbutton switch.

(c)Close-up
1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Restore system and aircraft to normal operating condition.

VERTICAL SPEED INDICATOR (5FL1-5FL2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-25-00, P. Block 501	Inertial Reference System

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For Captain vertical speed indicator :

PANEL	SERVICE	IDENT.	LOCATION
22VU	ADS/CAPT/ALTM & VSI	24FL1	204/F18
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

(b)For First Officer vertical speed indicator :

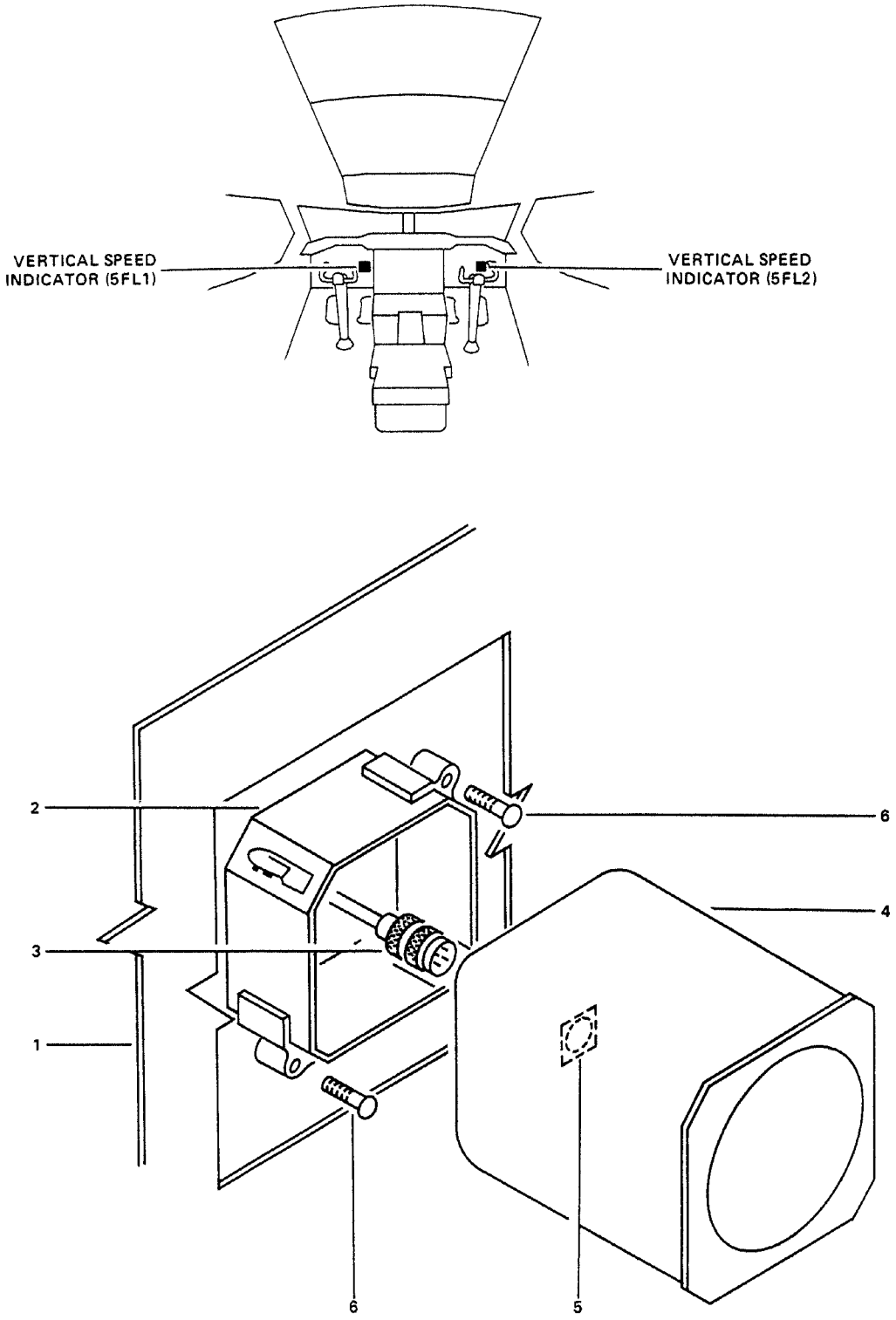
PANEL	SERVICE	IDENT.	LOCATION
21VU	ADS/F/O/ALTM & VSI	24FL2	105/E11
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

B. Removal

(1)Loosen the two screws (6) on clamp (2). Do not remove screws.
(2)Pull out VSI (4).
(3)Disconnect and cap electrical connector (3).
(4)Blank receptacle (5) on indicator (4).
(5)Remove indicator (4).

C. Installation

(1)Clean and inspect indicator (4) interface and/or adjacent area.
(2)Remove blanking caps from connector (3) and receptacle (5).
(3)Connect electrical connector (3) to indicator (4).
(4)Position indicator (4) in clamp (2).
(5)Secure indicator (4) to instrument panel (1) and tighten screws (6).
(6)Remove safety clips and tags and close the following circuit breakers :
(a)For Captain vertical speed indicator : 24FL1 and 1LF.
(b)For First Officer vertical speed indicator : 24FL2 and 1LF.



Vertical Speed Indicator
Figure 401

D. Test
Carry out bite test of IRS1 (2) (Ref. 34-25-00, P. Block 501).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

VERTICAL SPEED/TRAFFIC ADVISORY AND COLLOSION AVOIDANCE SYSTEM INDICATOR (15FL1-15FL2) REMOVAL/INSTALLATION

R

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-25-00, P. Block 501 (Ref. Fig. 401)	Inertial Reference System

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For Captain indicator :

PANEL	SERVICE	IDENT.	LOCATION
22VU	ADS/CAPT/ALTM & VSI	24FL1	204/F18
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

(b)For First Officer indicator :

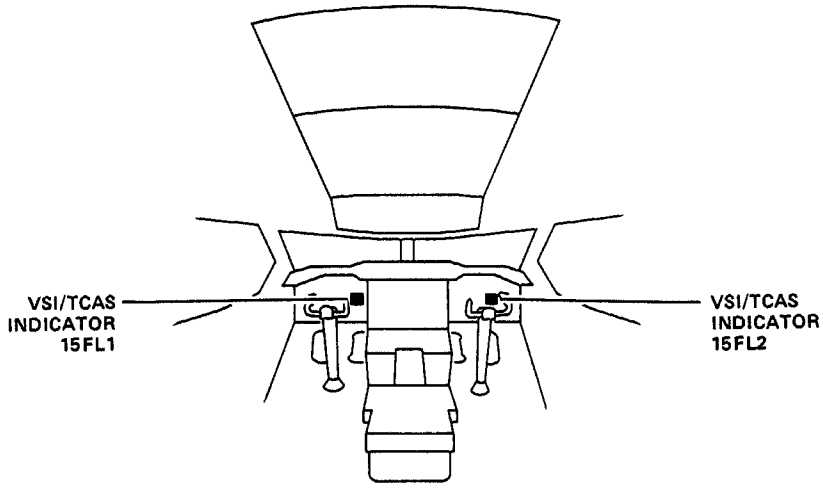
PANEL	SERVICE	IDENT.	LOCATION
21VU	ADS/F/O/ALTM & VSI	24FL2	105/E11
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

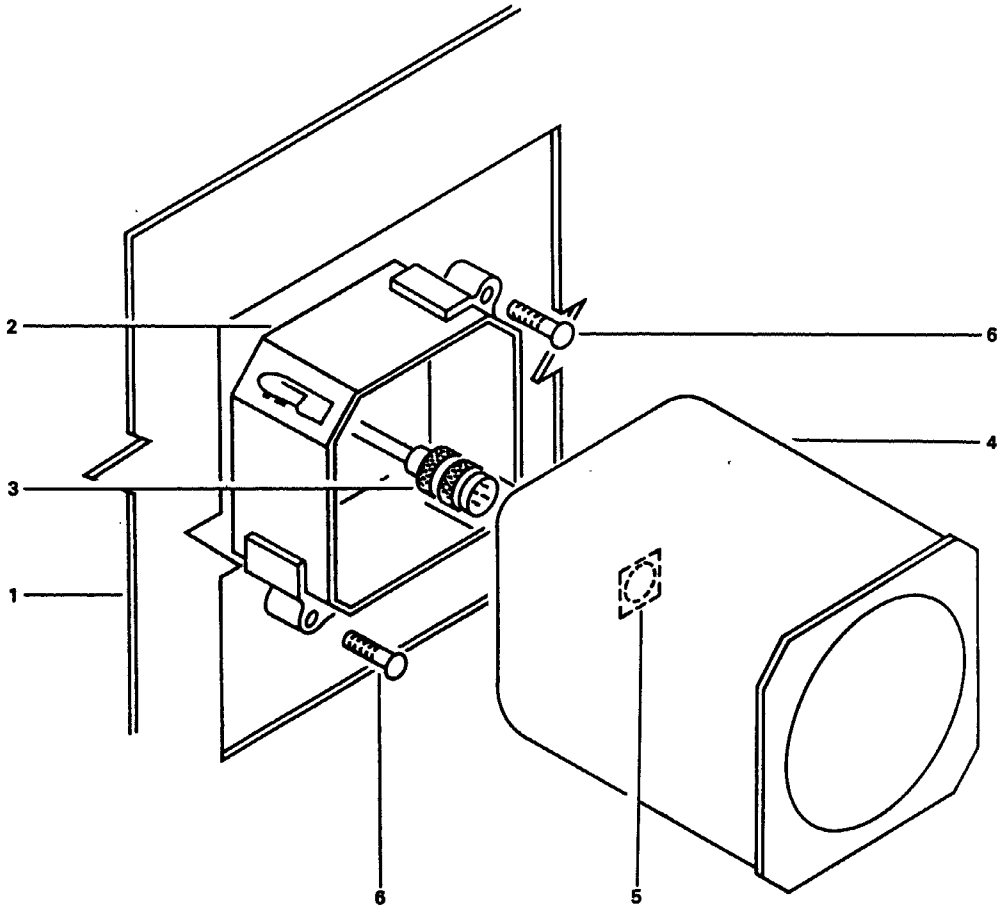
B. Removal

(1)Loosen the two screws (6) on clamp (2). Do not remove screws.
(2)Pull out indicator (4).
(3)Disconnect and cap electrical connector (3).
(4)Blank receptacle (5) on indicator (4).
(5)Remove indicator (4).

C. Installation

(1)Clean and inspect indicator (4) interface and/or adjacent area.
(2)Remove blanking caps from connector (3) and receptacle (5).
(3)Connect electrical connector (3) to indicator (4).
(4)Position indicator (4) in clamp (2).
(5)Secure indicator (4) to instrument panel (1) and tighten screws (6).
(6)Remove safety clips and tags and close the following circuit breakers :
(a)For Captain indicator : 24FL1 and 1FL.
(b)For First Officer indicator : 24FL2 and 1LF.





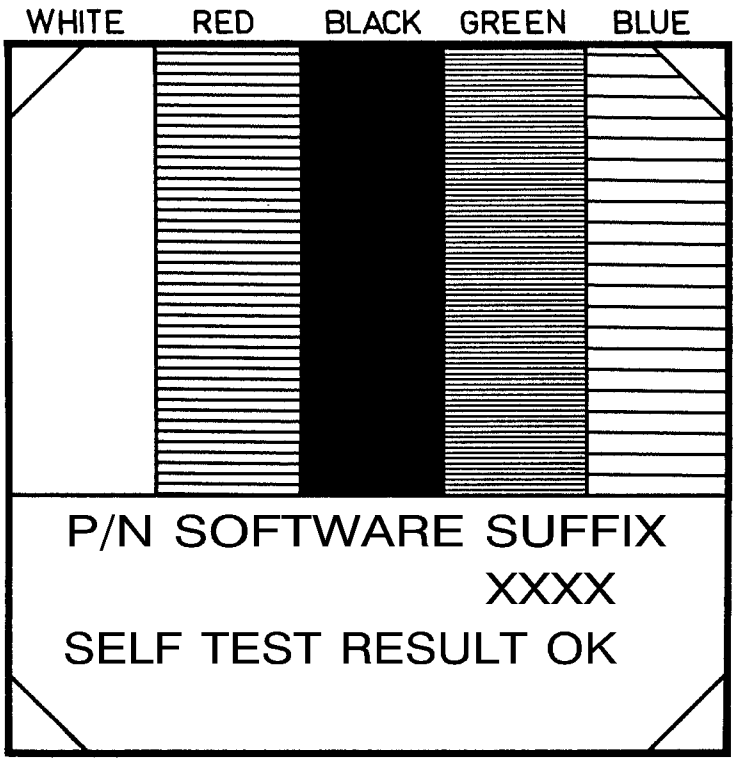
BM5 34 14 21 4 ACM2 00

VSI/TCAS Indicator
Figure 401

D. Test
- Carry out bite test of IRS1(2) (Ref. 34-25-00, P. Block 501).
- Place annunciator light test switch in TEST position, on overhead panel 436VU. Check that the test pattern appears on each indicator, composed of five vertical bands from left to right : white, red, black, green, blue.
  Below the test pattern : P/N SOFTWARE SUFFIX
  SELF TEST RESULT OK is written.
  On ATC/TCAS control box, check that ATC FAIL light goes on and that four "8" appear on the code display window.

(Ref. Fig. 402)

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.



BM5 34 14 21 4 AVM0 01

VSI/TCAS - Test Pattern
Figure 402

R EFFECTIVITY: 004-200,

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1. General

This information is supplied by the ADCs in the digital format and displayed on the various CRTs as indicated below :

TAS : - on Captain and First Officer Navigation Displays (ND).
SAT : - on right ECAM display unit (CRUISE page)
TAT : - on left ECAM display unit (MEMO page),
- on Thrust Rating Panel (TRP) connected to the TCC

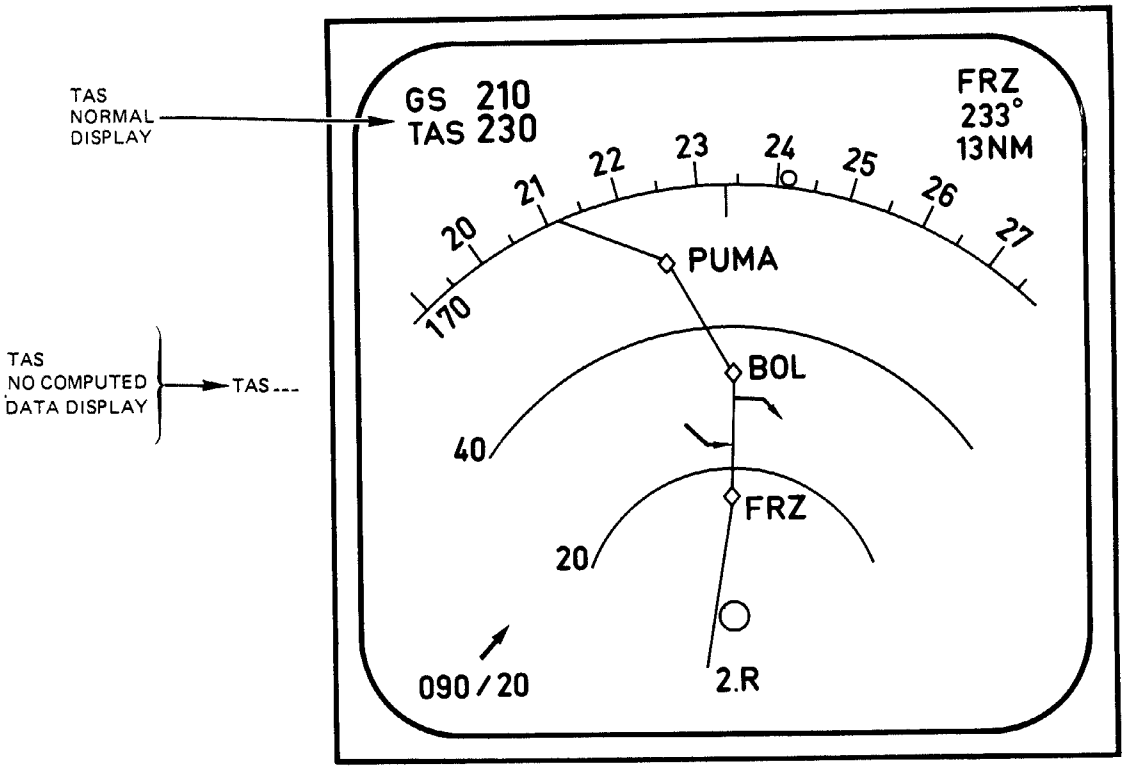
2. True Airspeed Indication on Navigation Display

A. Data Display

The Navigation Display displays the true airspeed computed by the ADC and processed by the associated SGU.
(Ref. Fig. 001)
This is a three-digit (green) item of information preceded by (green) TAS indication which is displayed in the upper LH side of the screen.
Only data greater than 100 kts (which is the ADC computation limit) is displayed.
In the case of data below 100 kts, TAS indication remains visible but is followed by three dashed lines.
In case of failure of ADC information, true airspeed reading disappears.

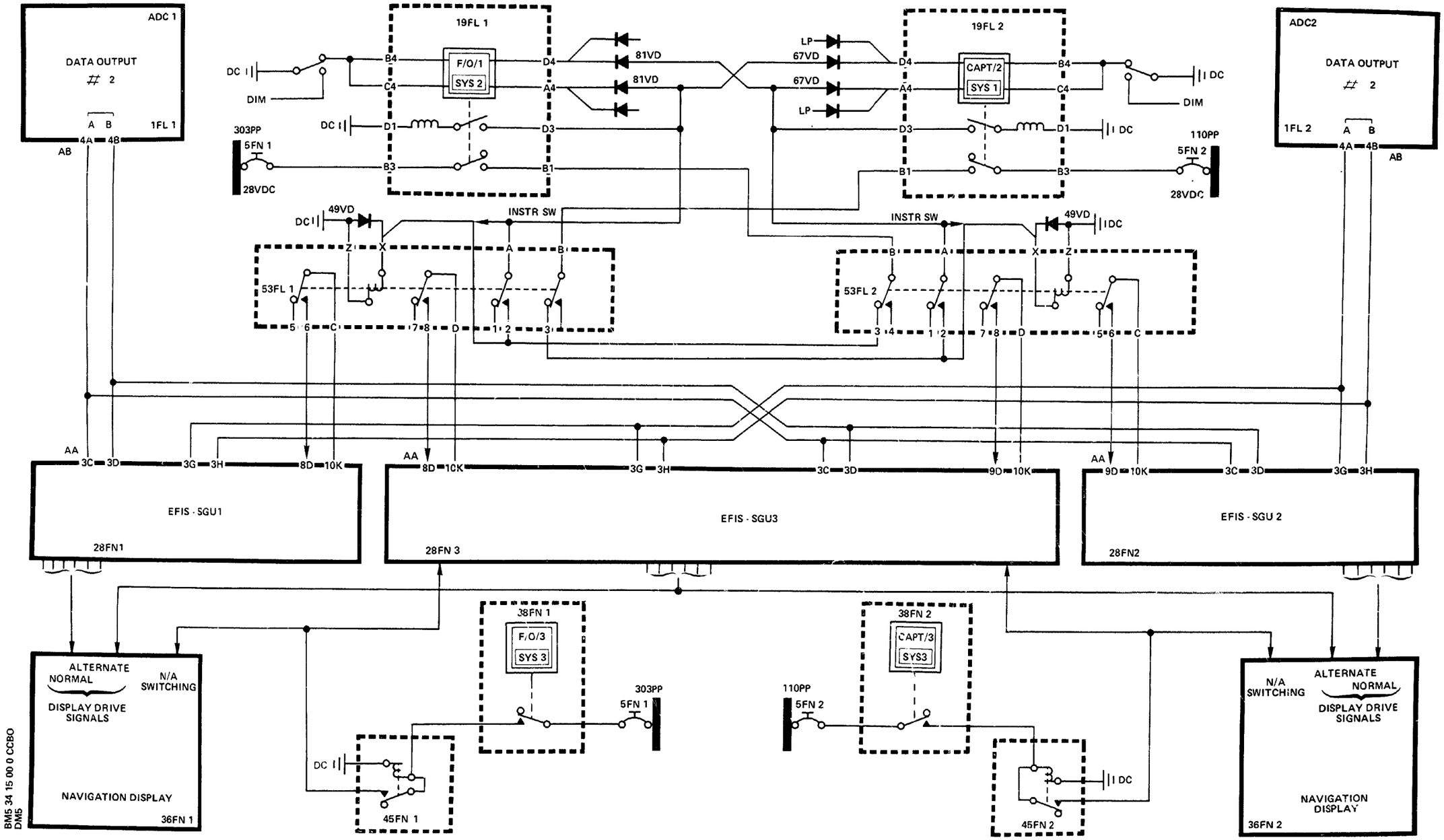
B. Distribution of True AIrspeed Data to NDs

The following figure shows the electrical diagram of ADC information in relation to the PFD and ND.
(Ref. Fig. 002)
Data bus No.2 from ADC1 normally supplies EFIS SGU1, which controls the Captain's ND.
Data bus No.2 from ADC2 normally supplies EFIS SGU2, which controls the First Officer's ND.
In the event of ADC failure, the SGU normally associated with the failed ADC can use data bus No.2 from ADC in operation.
In the event of failure of SGU1 or SGU2, either can be replaced by SGU3 after selection by the crew. The Captain has priority.
In these two cases, selection is made through illuminated pushbutton switches located on panels 402VU and 406VU.



BM5 34 15 00 0 C8P0.00

ND - TAS Indication
Figure 001

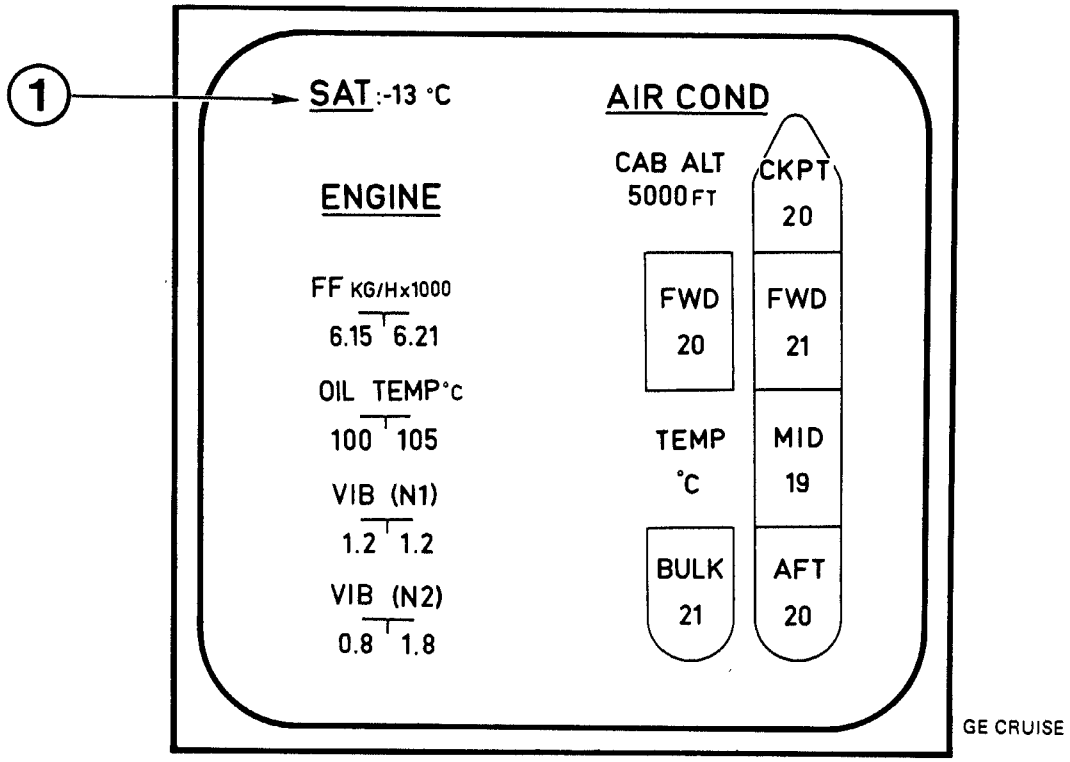


TAS Information - Electrical Diagram - Normal Circuit
Figure 002

3. Static Air Temperature Indication on Right ECAM Display Unit

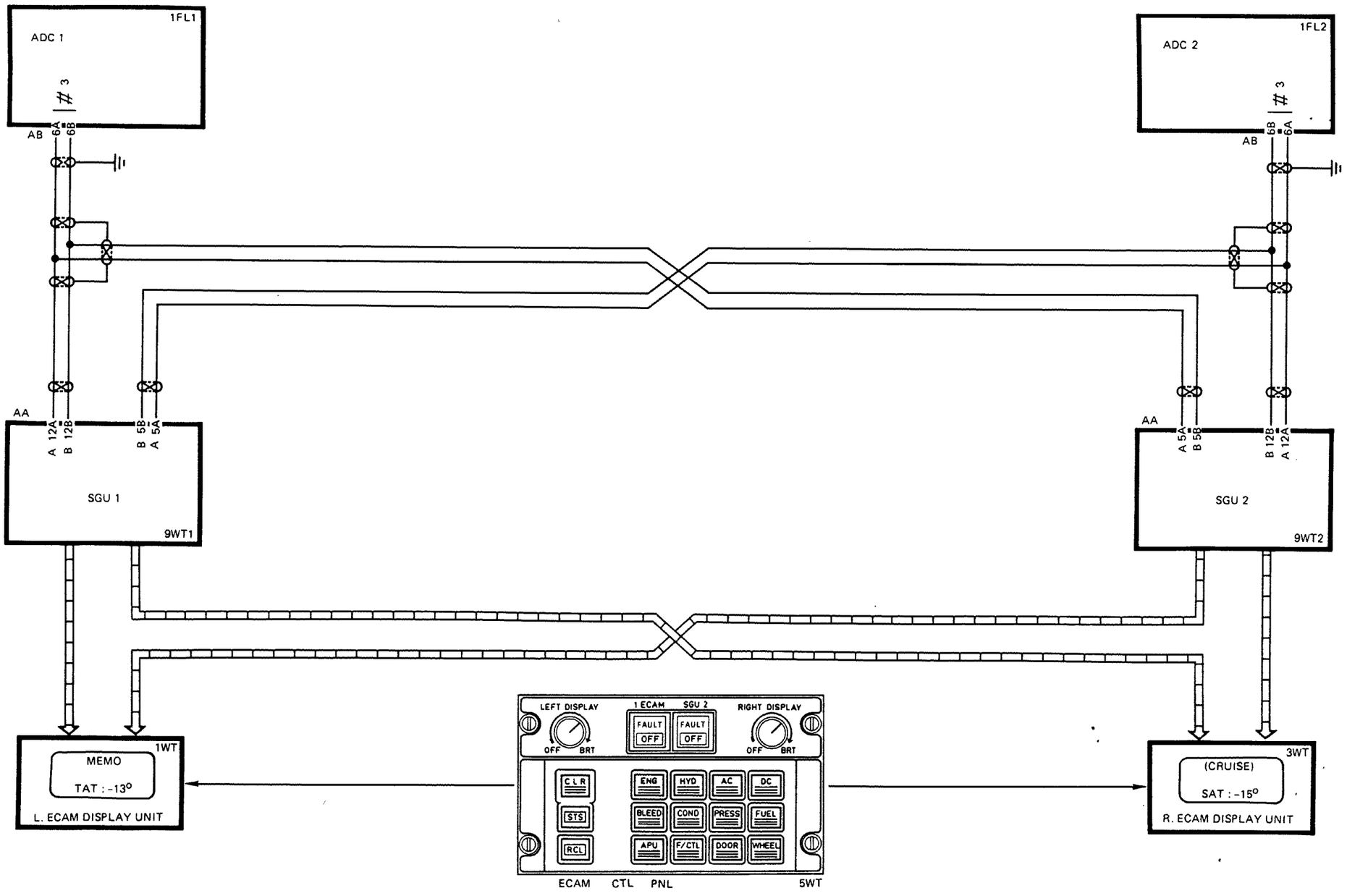
A. Data Display
(Ref. Fig. 003)
The right ECAM display unit displays static air temperature computed by the ADC and processed by the associated symbol generator. This is a two-digit (green) item of information (1) preceded by a sign and by (white) SAT indication, which is displayed in the LH upper part of the screen.
This information is displayed on CRUISE page.
In case of failure of SAT information, this information is displayed as follows :
SAT : XX°C
(XX is amber)

B. Distribution of Static Air Temperature Data to Right ECAM Display Unit
(Ref. Fig. 004)
Data bus No.3 from ADC1 normally supplies ECAM SGU2, which controls the right ECAM display unit.
In the event of failure, or when NCD information is received on SAT label of ADC1 bus, SGU2 automatically switches to data bus No.3 from ADC2.
In the event of failure of SAT label on both data busses No.3 from both ADCs, SAT indication is displayed with warning message on the right ECAM display unit : SAT : XX°C (XX is amber).
SGU2 failure is indicated by a diagonal line across the right ECAM display unit, and by illumination of FAULT indicator light associated with SGU2 on ECAM control panel, which is located on center pedestal.
Pressing this indicator light switches the right ECAM display unit to SGU1. FAULT indicator light goes off and OFF indicator light associated with SGU2 comes on. SAT information is then displayed again on the right ECAM display unit.



BM5 34 15 00 0 CCM0 00

Right ECAM Display Unit - SAT Indication
Figure 003



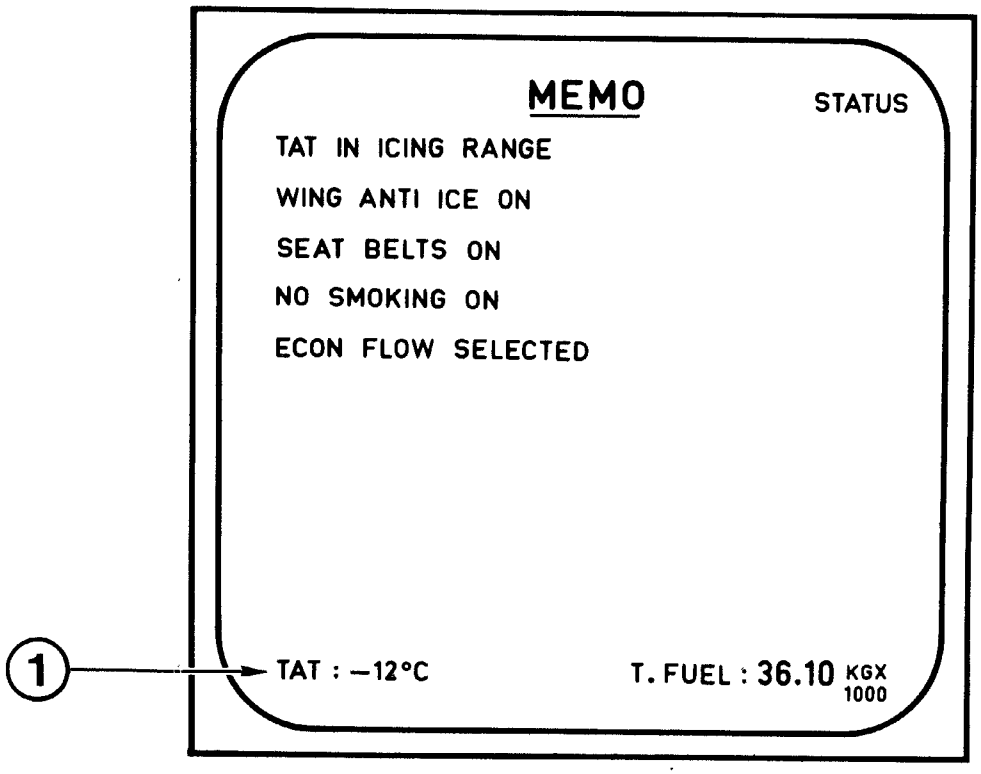
BM5 34 15 00 0 CCPO
DM5

SAT - TAT Information - Electrical Diagram
Figure 004

4. Total Air Temperature Indication on Left ECAM Display Unit

A. Data Display
(Ref. Fig. 005)
The left ECAM display unit displays total air temperature computed by the ADC and processed by the associated symbol generator.
This is a three-digit (green) item of information (1) preceded by its sign and (white) TAT indication, which is displayed in the LH lower corner of the screen.
This item of information is displayed on MEMO page.
In the event of failure of TAT information, this information is displayed as follows :
TAT : XX°C
(XX is amber)
When a warning message is displayed on the left ECAM display unit, MEMO page is cleared and only reappears after the warning message has been cleared.
NOTE : TAT is also displayed on the Thrust Rating Panel (TRP) connected to the TCC.

B. Distribution of Total Air Temperature Indication to Left ECAM Display Unit
Data bus No.3 from ADC1 normally supplies ECAM SGU1 which controls the left ECAM display unit.
In the event of failure, or when NCD information is received on TAT label of ADC1 bus, SGU1 automatically switches to data bus No.3 from ADC2.
In the event of failure of TAT label on both data busses No.3 from both ADCs, TAT indication is displayed with warning message on the left ECAM display unit :
TAT : XX°C
(XX is amber)
SGU1 failure is indicated by a diagonal line across the left ECAM display unit, and by illumination of FAULT indicator light associated with SGU1 on ECAM control panel, which is located on center pedestal.
Pressing this indicator light switches the left ECAM display unit to SGU2. FAULT indicator light goes off and OFF indicator light associated with SGU1 comes on. TAT information is then displayed again on the left ECAM display unit.



BM5 34 15 00 0 CCTO-00

Left ECAM Display Unit - TAT Indication
Figure 005

**ON A/C 001-003,

(Ref. Fig. 001)

R **ON A/C 004-200,

(Ref. Fig. 002)

**ON A/C 001-003,

1. Instrument Switching
In case of failure detected in an ADC, the associated indicators :
- altimeter
- vertical speed indicator
- PFD and ND (through associated SGU)
can be supplied from the ADC in operation since a switching capability is integrated to the instruments or SGUs, and controlled through pushbutton switches at the pilot's disposal, on panels 402VU and 406VU.
When switching is performed by one pilot, any action from the other pilot is inhibited, so as to prevent information crossfeed.
Apart from switchover of sources of ADC information displayed on the instruments, switchover of ADC inputs inside the IRS is also performed.

R **ON A/C 004-200,

1. Instrument Switching
In case of failure detected in an ADC, the associated indicators :
- altimeter
- Vertical Speed/TCAS indicator
- PFD and ND (through associated SGU)
can be supplied from the ADC in operation since a switching capability is integrated to the instruments or SGUs, and controlled through pushbutton switches at the pilot's disposal, on panels 402VU and 406VU.
When switching is performed by one pilot, any action from the other pilot is inhibited, so as to prevent information crossfeed.
Apart from switchover of sources of ADC information displayed on the instruments, switchover of ADC inputs inside the IRS is also performed.

**ON A/C ALL

2. VMO/MMO Switching
One VMO/MMO law is memorized for the aircraft :
- Basic law : 340 kts/M = 0,84 : this law is used for ADC VMO output data

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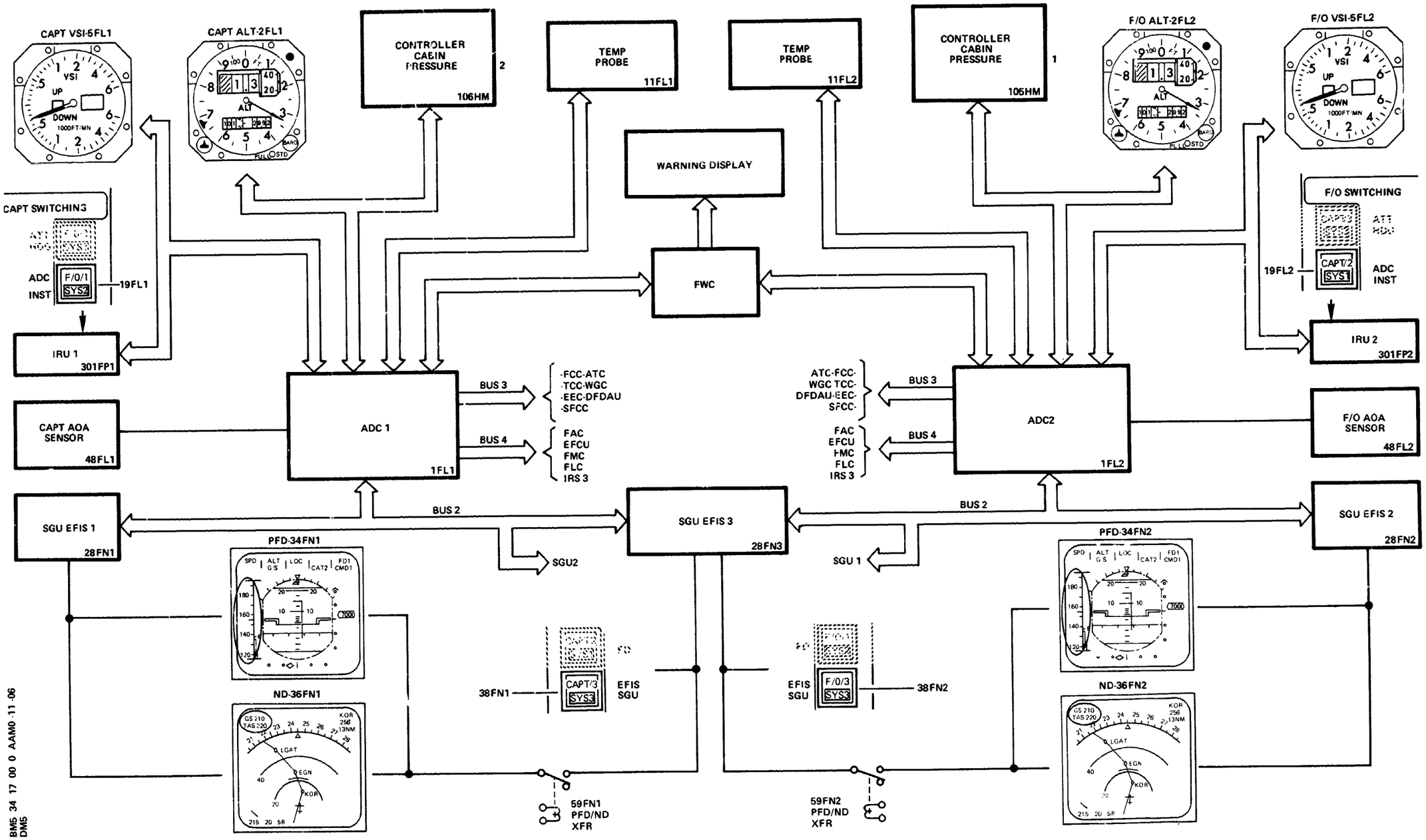

BM5 34 17 00 0 AAM0 11-06
DM5

ADS Instrument Switching
Figure 001

R EFFECTIVITY: 001-003,

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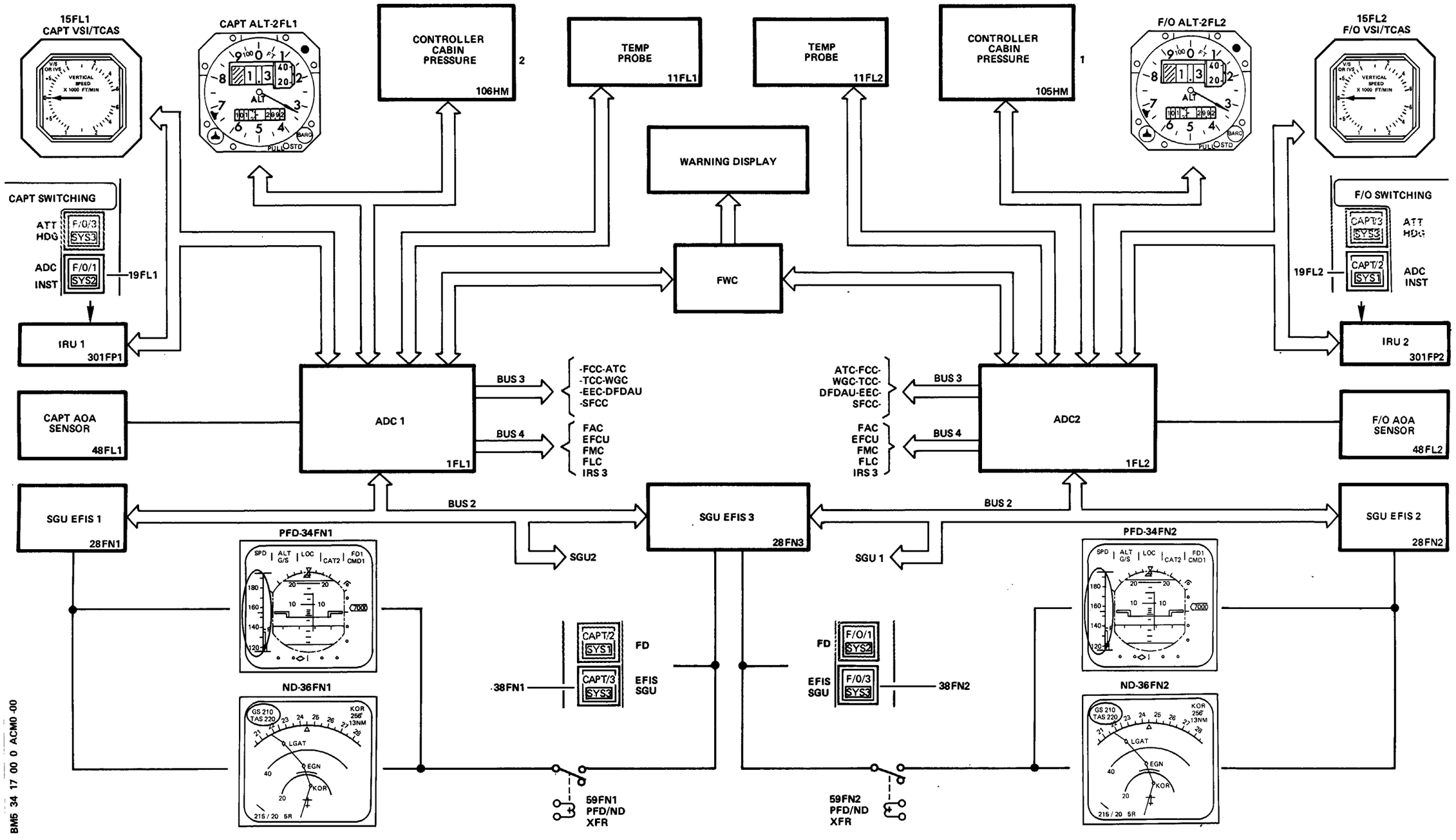


BM5 34 17 00 0 ACM0 00

ADS Instrument Switching
Figure 002

ADS TEST - DESCRIPTION AND OPERATION

Test circuits enable on the ground :
- **ADC** functional test : simulation of a flight configuration for **ADC** various outputs.
- **ALPHA** probe test, by means of a probe positioning electromechanical device.

1. Control Device Location
   Tests are controlled through five illuminated pushbutton switches located on panel **47OVU** :
   - **ADS1** and **ADS2** : when a test is initiated, the lower section of these push-button switches is illuminated.
   - **ALPHA PROBES**
     Three pushbutton switches : **CAPT, F/O** and **ALL,** control respectively :
     . Captain's probe test
     . First Officer's probe test
     . simultaneous test of all three probes : **CAPT, F/O** and third probe used by the automatic flight control and navigation aid systems.

2. ADC Functional Test
   When **ADC1** or **ADC2** pushbutton switch is pressed, the following sequence is performed at the level of **ADC** outputs :
   - outputs which are not valid during five seconds :
     FAILURE WARNING status matrix is encoded in all the parameters that take the following values at the beginning of test.
   - evolution of parameters during **5** seconds, in relation to a decrease of static pressure at a speed of **600** ft./mn.
     FUNCTIONAL TEST status matrix is then encoded in all parameters.
   - after **5** seconds, the outputs return to the following values which are stable, as long as the functional test is activated.
     FUNCTIONAL TEST status matrix is encoded in all parameters.

PARAMETERS	TEST VALUE
Altitude	10000 ft.
Mach	0,66
TAT	+35°C
AOA indicated	+5°
Altitude Rate	0 ft./mn
Static Pressure (Ps)	20,577 ± 0,001 in Hg
Total Pressure (Pt)	933.46 ± 0.3 mb
Impact Pressure (Qc)	236.64 ± 0.3 mb
C A S	367,7 ± 0,5 kts
T A S	433 ± 0,5 kts
S A T	+10,3°C
Baro Correction	0 ft.

The outputs which are not indicated take values in accordance with the values mentioned above, taking account of **VMO** and angle-of-attack computation laws selected.
Moreover, during the functional test, a seven-segment type digital display on

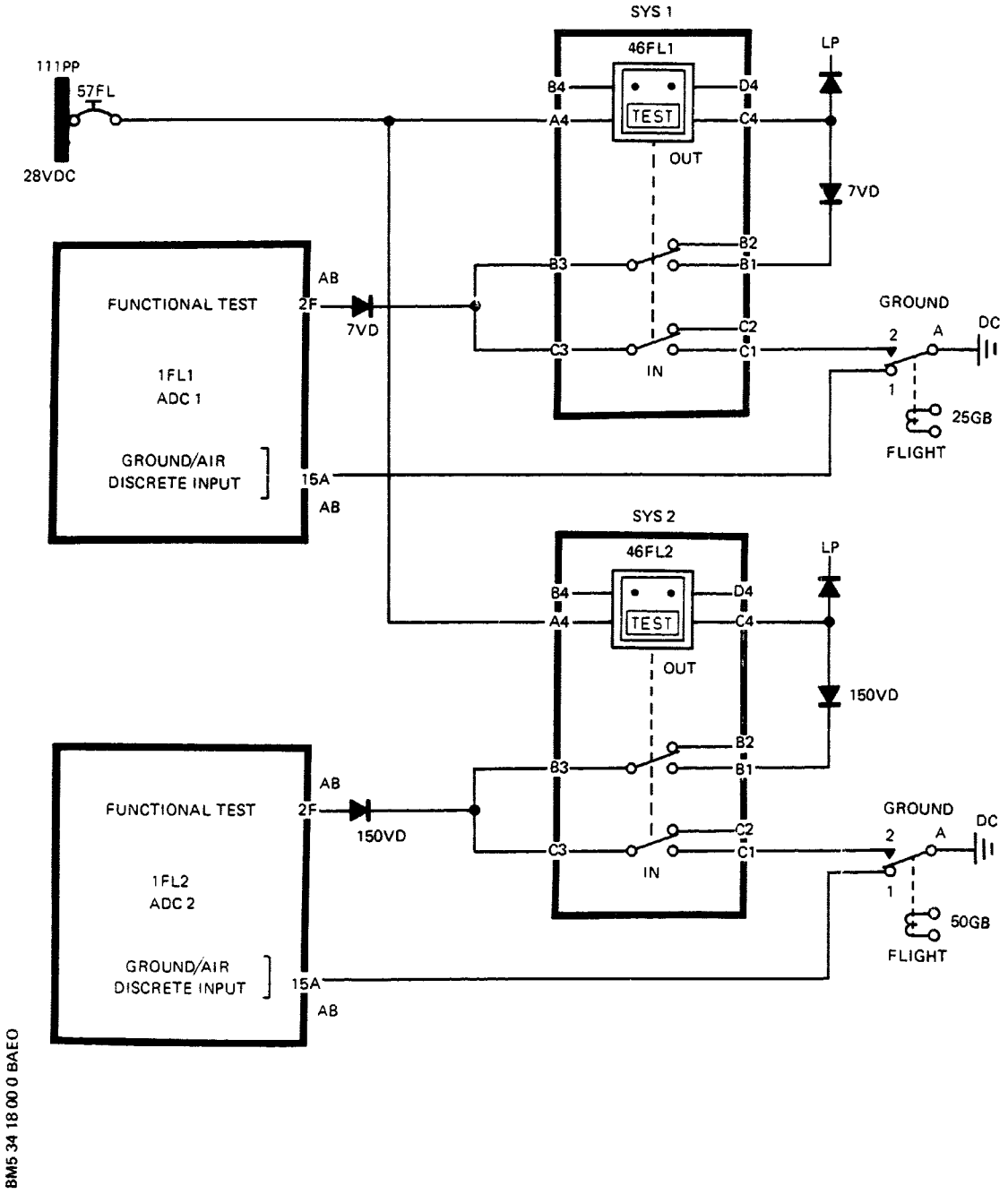
ADC face enables detection of failures of certain element connected with the ADC1, which cause the failure of ADC outputs.
The encoding of these failure indications is as follows :

Number	Failure Origin
1	Primary Angle of Attack No.1 input
2	Primary Angle of Attack No.2 input
3	Spare
4	Spare
5	Total Air Temperature Input
6	Baro-correction Input No.1
7	Baro-correction Input No.2
8	Spare
9	Aircraft Type Program (Wiring Error)
0	Ps probe ≠ Pt probe (during test)

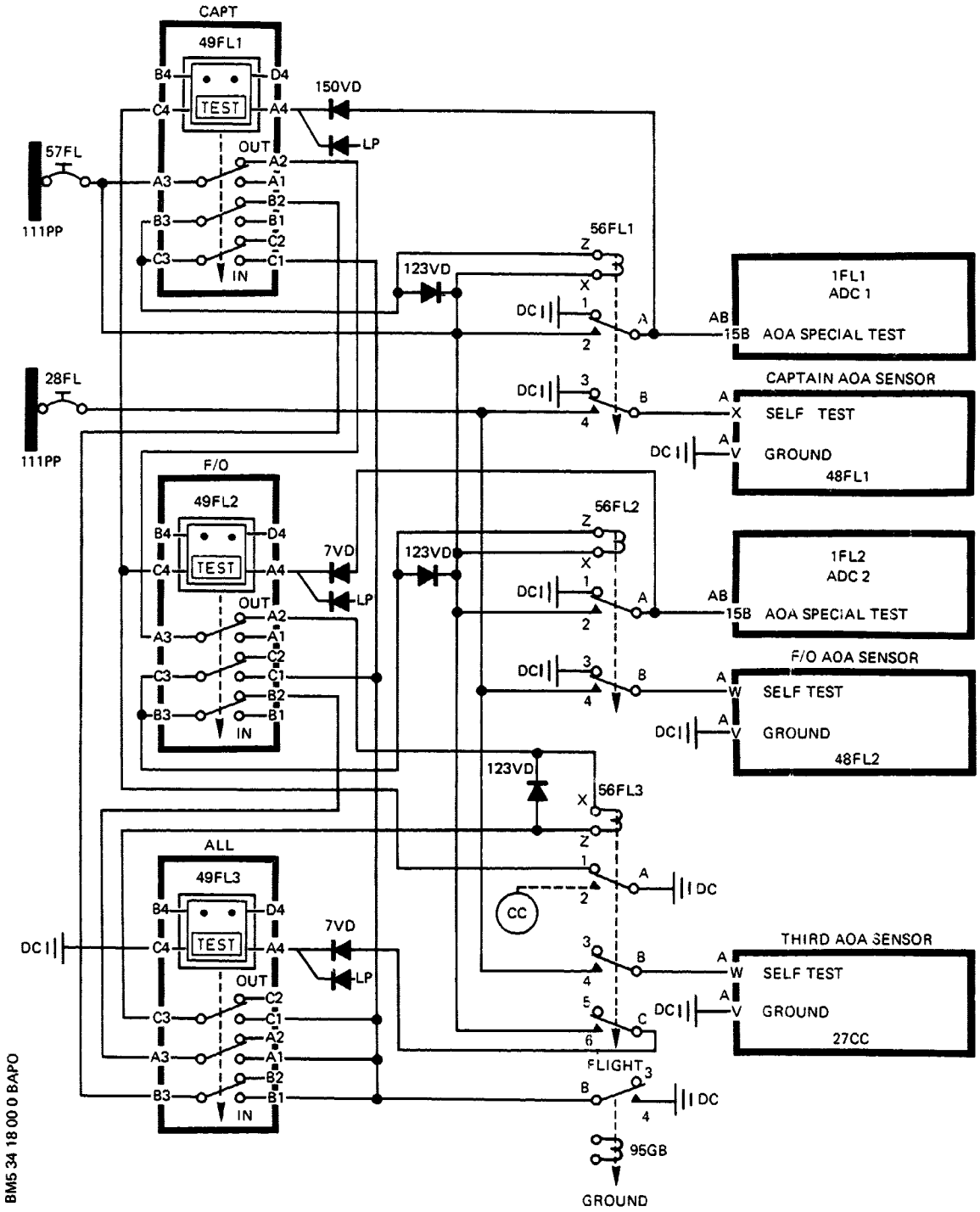
The following figure shows the electrical diagram of ADC test circuit (Ref. Fig. 001)

3. ALPHA Probe Test
(Ref. Fig. 002)
When ALPHA PROBES test pushbutton switch(es) is (are) pressed, the associated probe(s) outputs are positioned at a fixed value equal to +41° local incidence.
Positioning of the mobile parts (vane, mechanism, damper, output resolvers) is achieved by a solenoid driving an actuator arm which is mechanically linked to the probe rotation axis.
When the test is activated, the ADC takes into account the resolver signals of the associated probe, and produces indicated angle-of-attack and corrected angle-of-attack outputs in accordance with these signals :
- local AOA : +41 degrees
- corrected AOA : in accordance with local AOA value, depending on correction law selected.

The status matrix of indicated and corrected angle-of-attack parameters is thus positioned according to FUNCTIONAL TEST code.
NOTE : ADC1 and 2 functional test overrides ALPHA probes 1 and 2 test.



ADC1 and ADC2 Test Control
Figure 001



ALPHA Probe Test Control
Figure 002

R ATTITUDE AND DIRECTION - DESCRIPTION AND OPERATION

1. General

The Attitude and Direction system is made up of :

- Three Inertial Reference Systems (IRS) which mainly provide : Attitude, Heading, Ground Speed and Present Position information
- One Standby Horizon Indicator
- One Standby Compass.

Attitude and heading data is provided to the crew by :

- main instruments : EFIS, PFD and ND and instruments : ADF RMI and VOR/DME/RMI, which recopy the attitude and heading data delivered by the IRS.
- standby instruments : Horizon indicator and compass

2. Component Location
(Ref. Fig. 001)
(Ref. Fig. 002)
(Ref. Fig. 003)

**ON A/C 001-003,

(Ref. Fig. 004)

**ON A/C 004-100,

(Ref. Fig. 005)

R **ON A/C 101-200,

R (Ref. Fig. 006)

**ON A/C ALL

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
10FN1	RMI-VOR/DME, CAPT	3VU	211		34-29-22
10FN2	RMI-VOR/DME, F/O	5VU	212		34-29-22
15FN1	P/BSW-ATT HDG, CAPT	402VU	211		
15FN2	P/BSW-ATT HDG, F/O	406VU	212		
24FN1	RMI-ADF, CAPT	3VU	211		34-29-23
24FN2	RMI-ADF, F/O	5VU	212		34-29-23
25FN1	IND-STBY HORIZON	4VU	210		34-27-21
31FN	COMPASS-STBY		210		34-28-21
34FN1	PFD-CAPT	3VU	211		34-74-22
34FN2	PFD-F/O	5VU	212		34-74-22
36FN1	ND-CAPT	3VU	211		34-75-22
36FN2	ND-F/O	5VU	211		34-75-22
38FN1	P/BSW-EFIS SGU, CAPT	402VU	211		
38FN2	P/BSW-EFIS SGU, F/O	406VU	212		
49FN1	POT-PFD BRIGHTNESS ADJ, CAPT	413VU	211		
49FN2	POT-PFD BRIGHTNESS ADJ, F/O	412VU	212		
50FN1	POT-ND BRIGHTNESS ADJ, CAPT	413VU	211		
50FN2	POT-ND BRIGHTNESS ADJ, F/O	412VU	212		

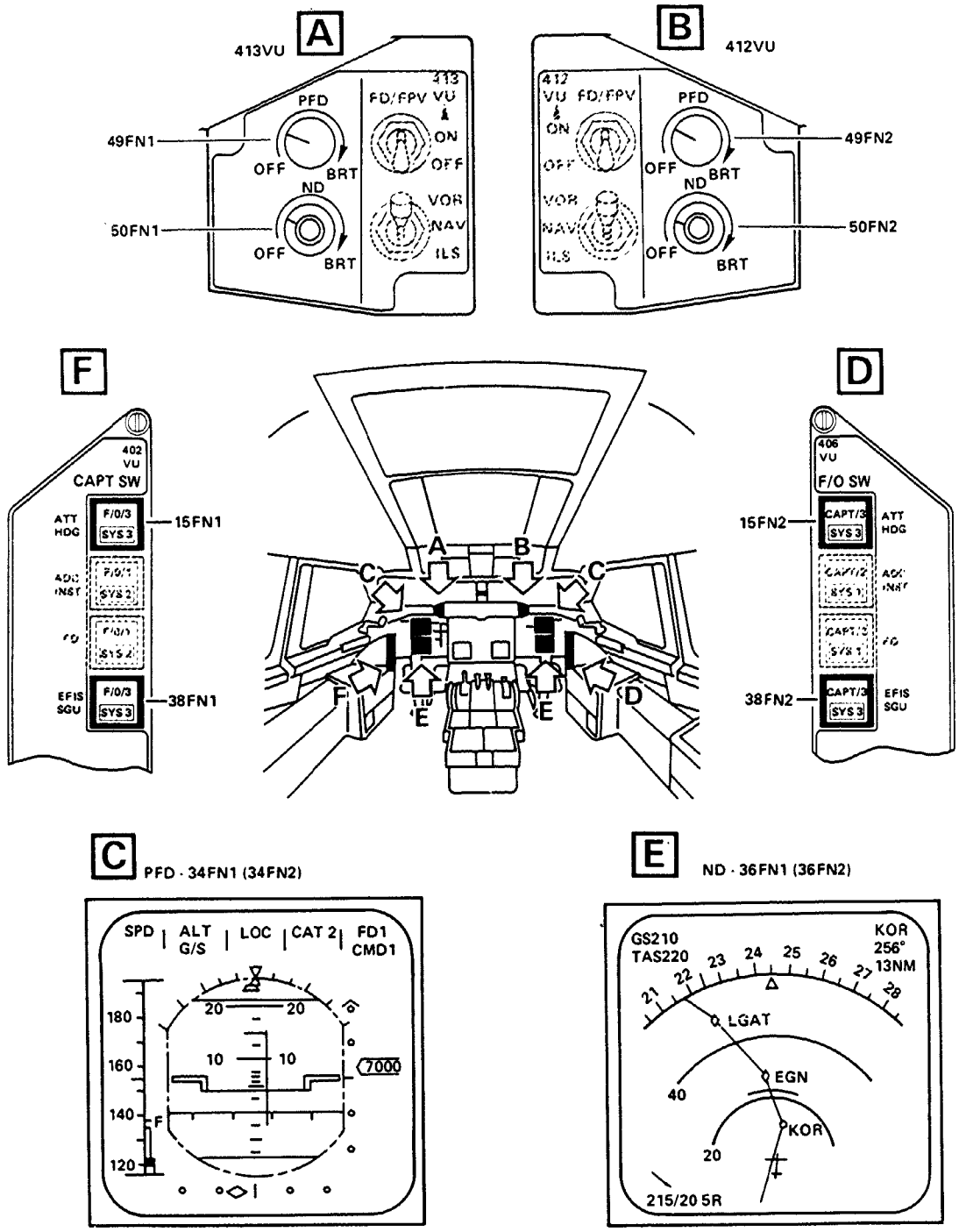
**ON A/C 001-003,

5FL1	IND-VERTICAL SPEED, CAPT	3VU	211		34-14-21
5FL2	IND-VERTICAL SPEED, F/O	5VU	212		34-14-21

R **ON A/C 004-200,

15FL1	IND-VSI/TCAS,CAPT	3VU	211		34-14-21
15FL2	IND-VSI/TCAS,F/O	5VU	212		34-14-21

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
**ON A/C ALL					
301FP1	IRU-1		121	121BL	34-25-34
301FP2	IRU-2		121	121BL	34-25-34
301FP3	IRU-3		121	121BL	34-25-34
309FP1	P/B SW-IRS1	470VU	212		
309FP2	P/B SW-IRS2	470VU	212		
309FP3	P/B SW-IRS3	470VU	212		
310FP1	MSU-1	20VU	210		34-25-25
310FP2	MSU-2	20VU	210		34-25-25
310FP3	MSU-3	20VU	210		34-25-25
311FP	ISDU	20VU	210		34-25-14
208LF	SWITCH-STBY COMPASS	436VU	212		
1WT	DISPLAY UNIT-ECAM, L	4VU	210		31-57-22
37WW	WARNING LIGHT - MASTER CAUTION, CAPT	3VU	211		
39WW	WARNING LIGHT - MASTER CAUTION, F/O	5VU	212		



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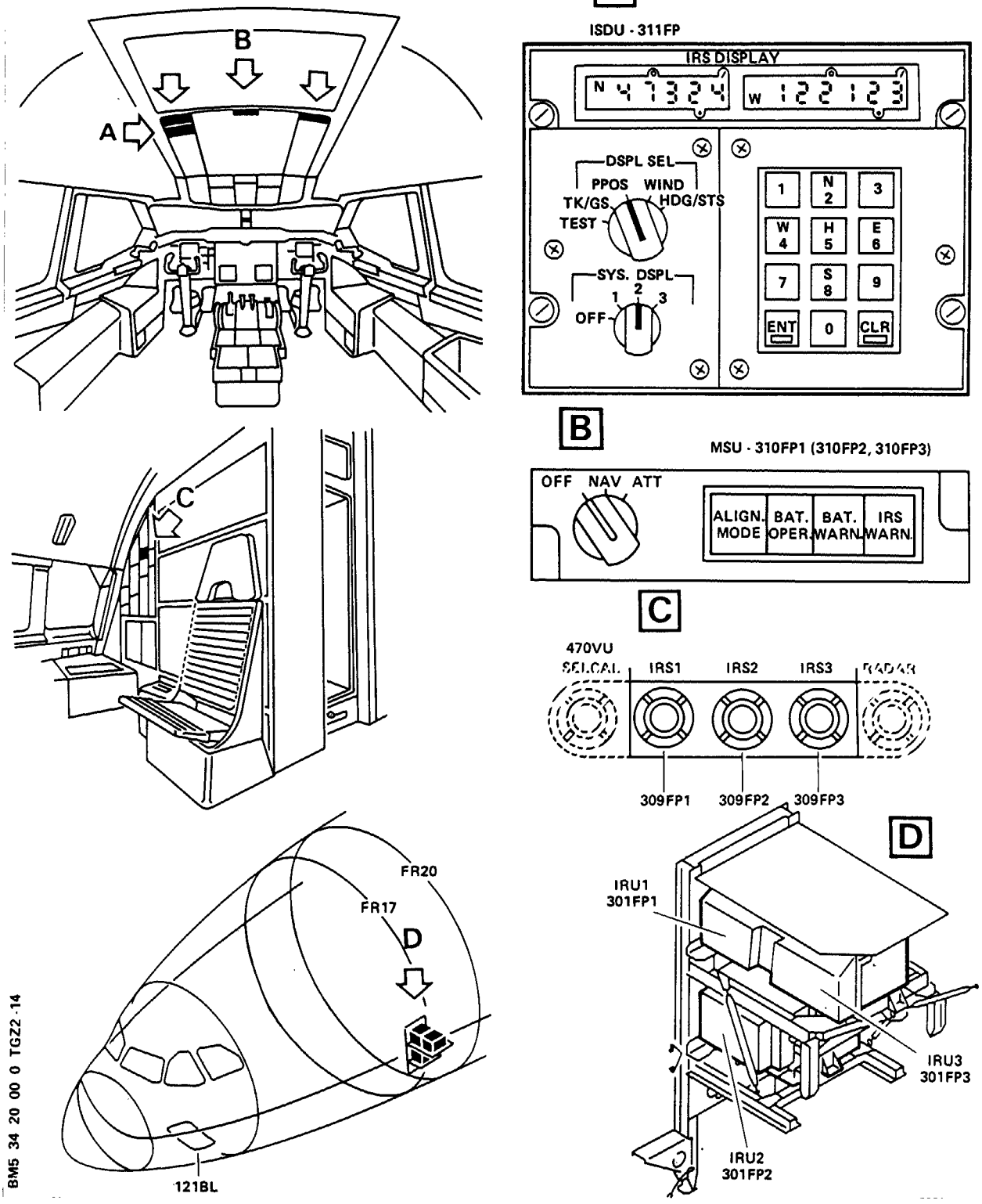
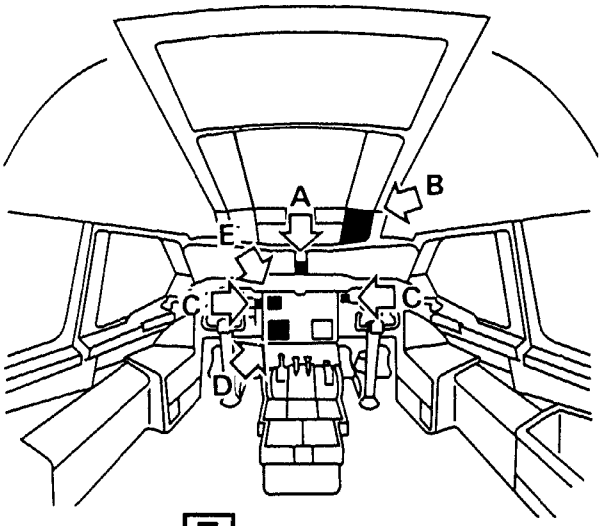
DM5

Attitude and Direction - Component Location - Sheet 1/4
Figure 001



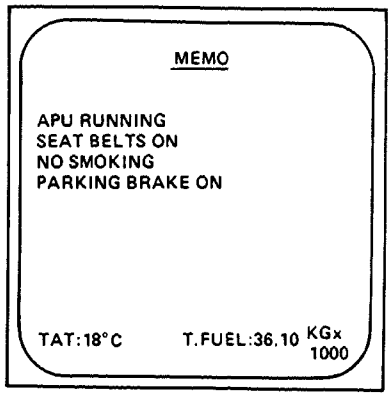
BM5 34 20 00 0 TGZ2 14

Attitude and Direction - Component Location - Sheet 2/4
Figure 002



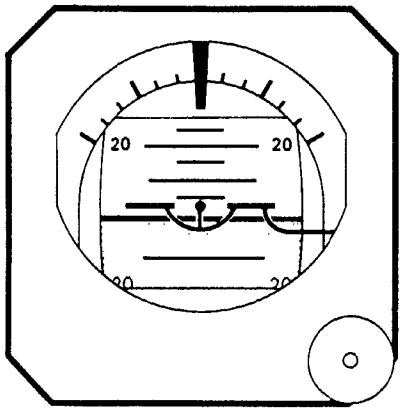
D

L ECAM DISPLAY UNIT - 1WT



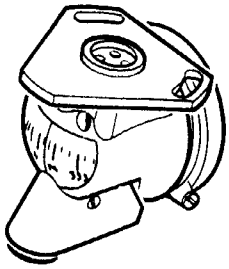
E

STBY HORIZON INDICATOR - 25FN1



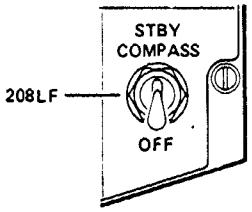
A

STBY COMPASS - 31FN



B

SWITCH - STBY COMPASS 436VU



C

MASTER CAUTION LIGHT 37WW (39WW)

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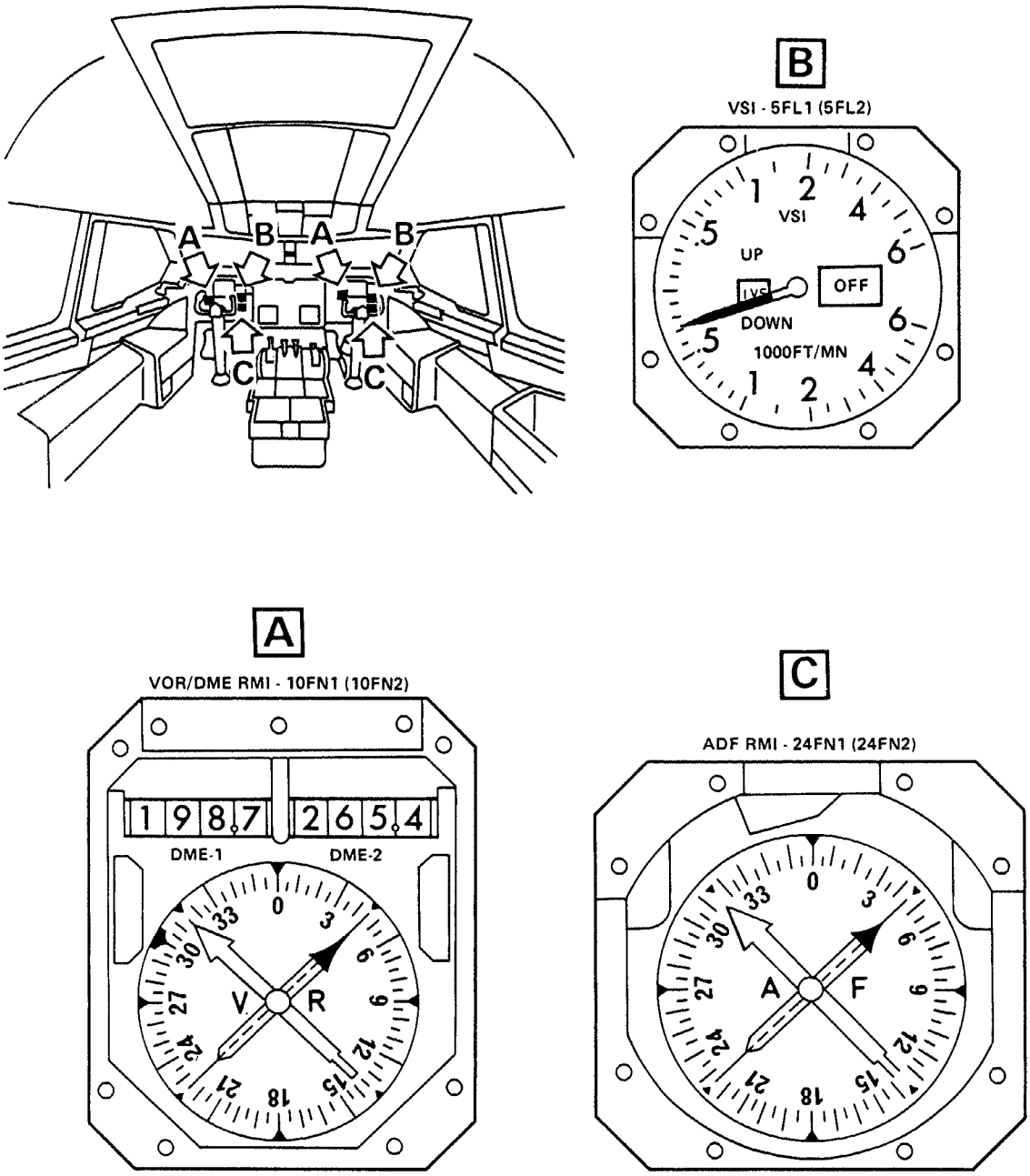
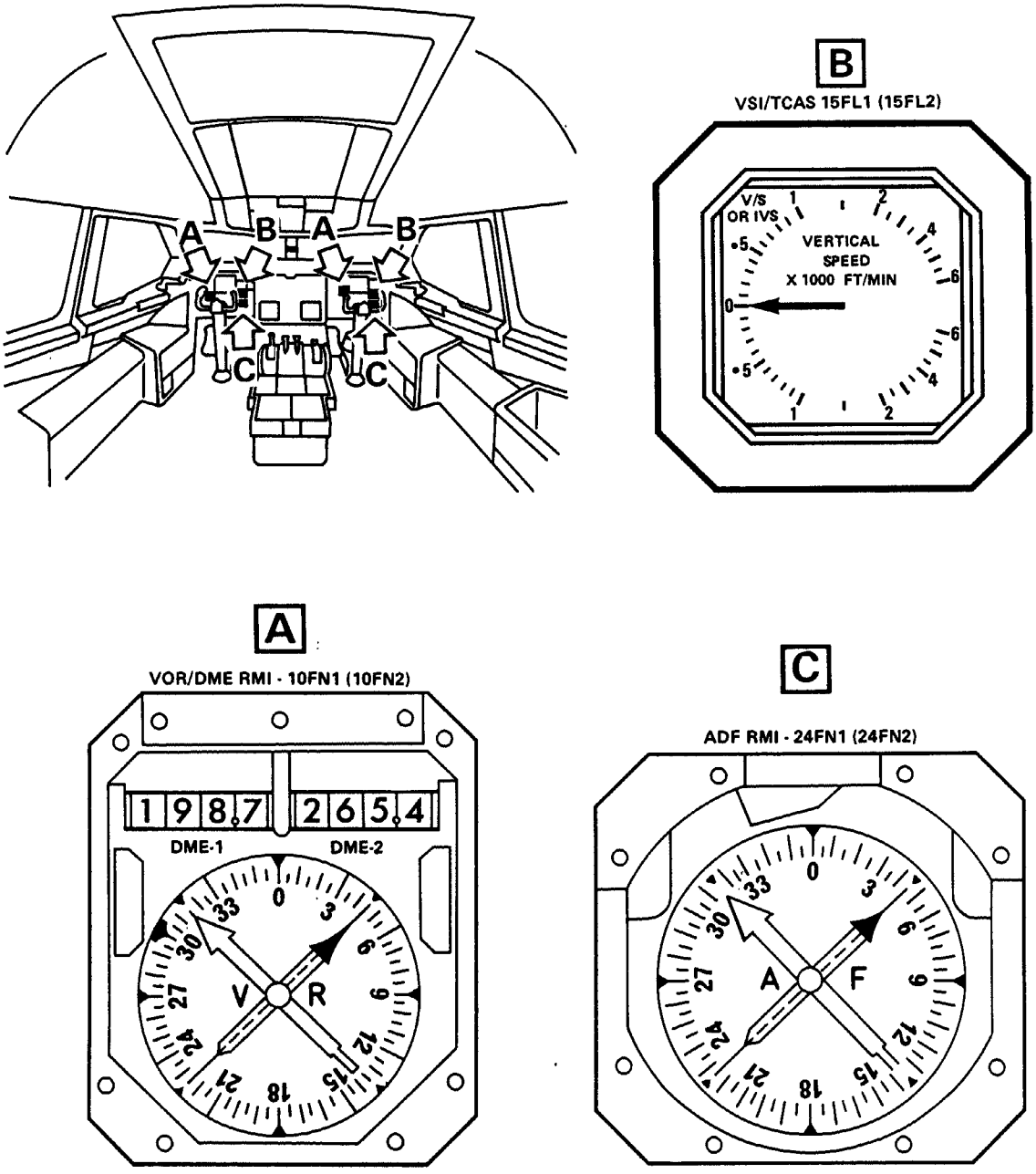
DM5

Attitude and Direction - Component Location - Sheet 3/4
Figure 003



BM5 34 20 00 0 TGW2 14 09
DM5

Attitude and Direction - Component Location - Sheet 4/4
Figure 004



BM5 34 20 00 0 TGF2 00

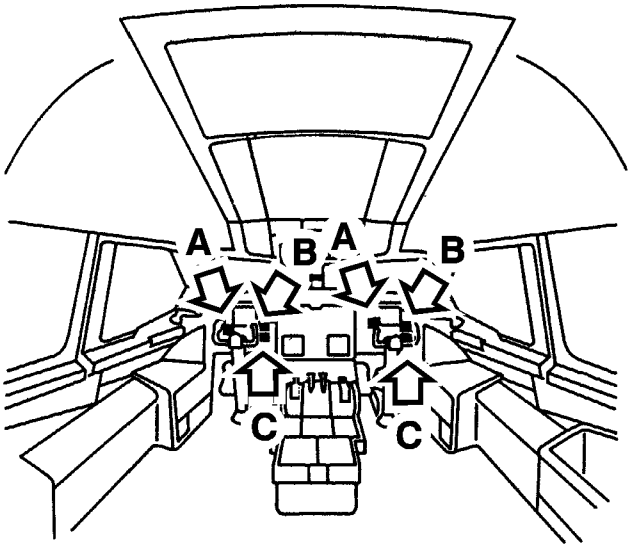
Attitude and Direction - Component Location - Sheet 4/4
Figure 005

R

R EFFECTIVITY: 004-100,

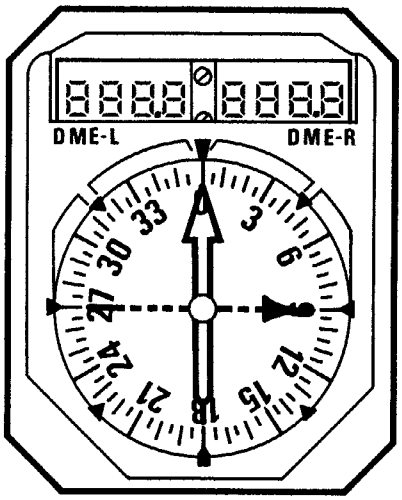
PIA

Printed in France



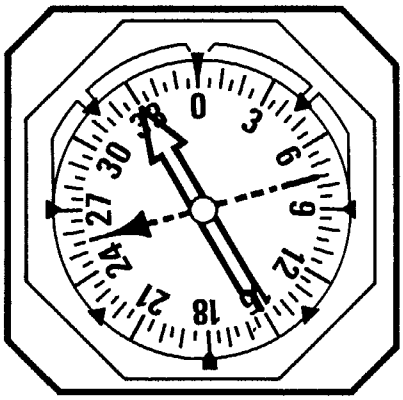
A

VOR/DME RMI - 10FN1 (10FN2)



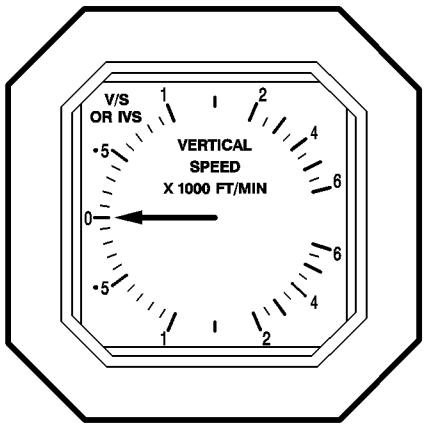
C

ADF RMI - 24FN1 (24FN2)



B

VSI/TCAS 15FL1 (15FL2)



BM5 34 20 00 0 TGJ2 00

Attitude and Direction - Component Location - Sheet 4/4

R Figure 006

3. Description

**ON A/C 001-003,

(Ref. Fig. 007)

R **ON A/C 004-200,

(Ref. Fig. 008)

**ON A/C ALL

The system provides Attitude and Heading data to the crew and to other systems.

A. Data Provided to the Crew

(1)Attitude data : main systems.

In normal operation, this data is displayed by :

- the CAPT PFD located on Captain's main instrument panel, driven by the EFIS SGU1 which receives data from the IRS1 in ARINC 429 type bus line form.
- the F/O PFD on First Officer's main instrument panel, driven by the EFIS SGU2 which receives data from the IRS2.

The IRS3 is connected to the EFIS SGU1 and 2 and can replace the IRS1 or IRS2 in case of a failure of these components. This reconfiguration is also manually controlled by the crew.

An EFIS SGU3 can replace the EFIS SGU1 or EFIS SGU2 in case of a failure of these components. This reconfiguration is also manually controlled by the crew.

(2)Attitude data : standby system

This data is displayed by a standby horizon indicator located on the center instrument panel.

(3)Heading data : normal system

In normal operation, the magnetic heading data is displayed as follows :

- On Captain's main instrument panel

The CAPT ND which is driven by the EFIS SGU1 displays data received from the IRS1 and transmitted by ARINC 429 type bus line which also transmits attitude data.

The CAPT VOR/DME RMI recopies data received from the IRS1 and transmitted by a bus line isolated from that used by the EFIS SGU1.

The CAPT ADF RMI recopies data received from the IRS2 and transmitted by a bus line.

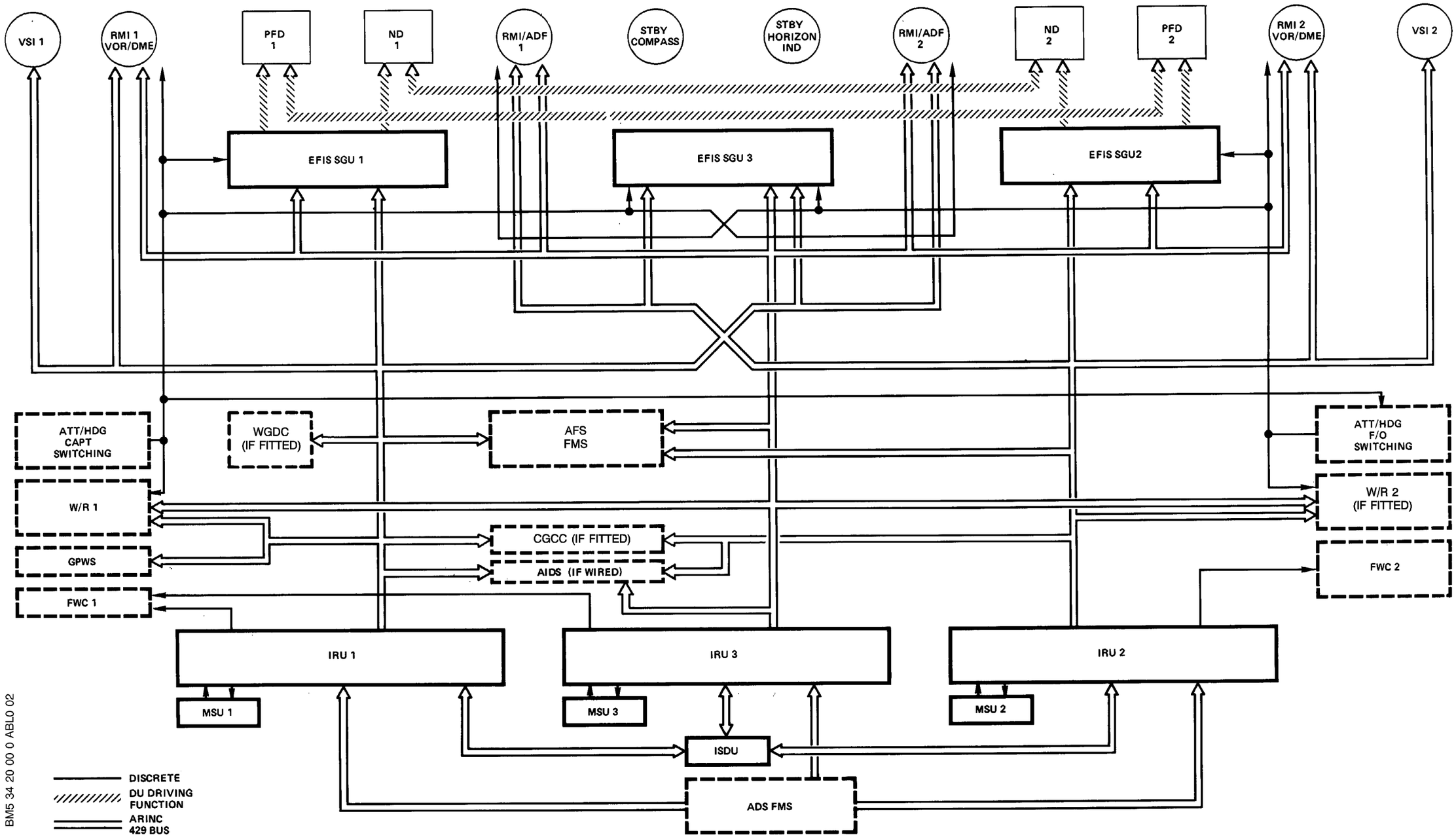
- On First Officer's main instrument panel

The F/O ND which is driven by the EFIS SGU2 displays data received from the IRS2.

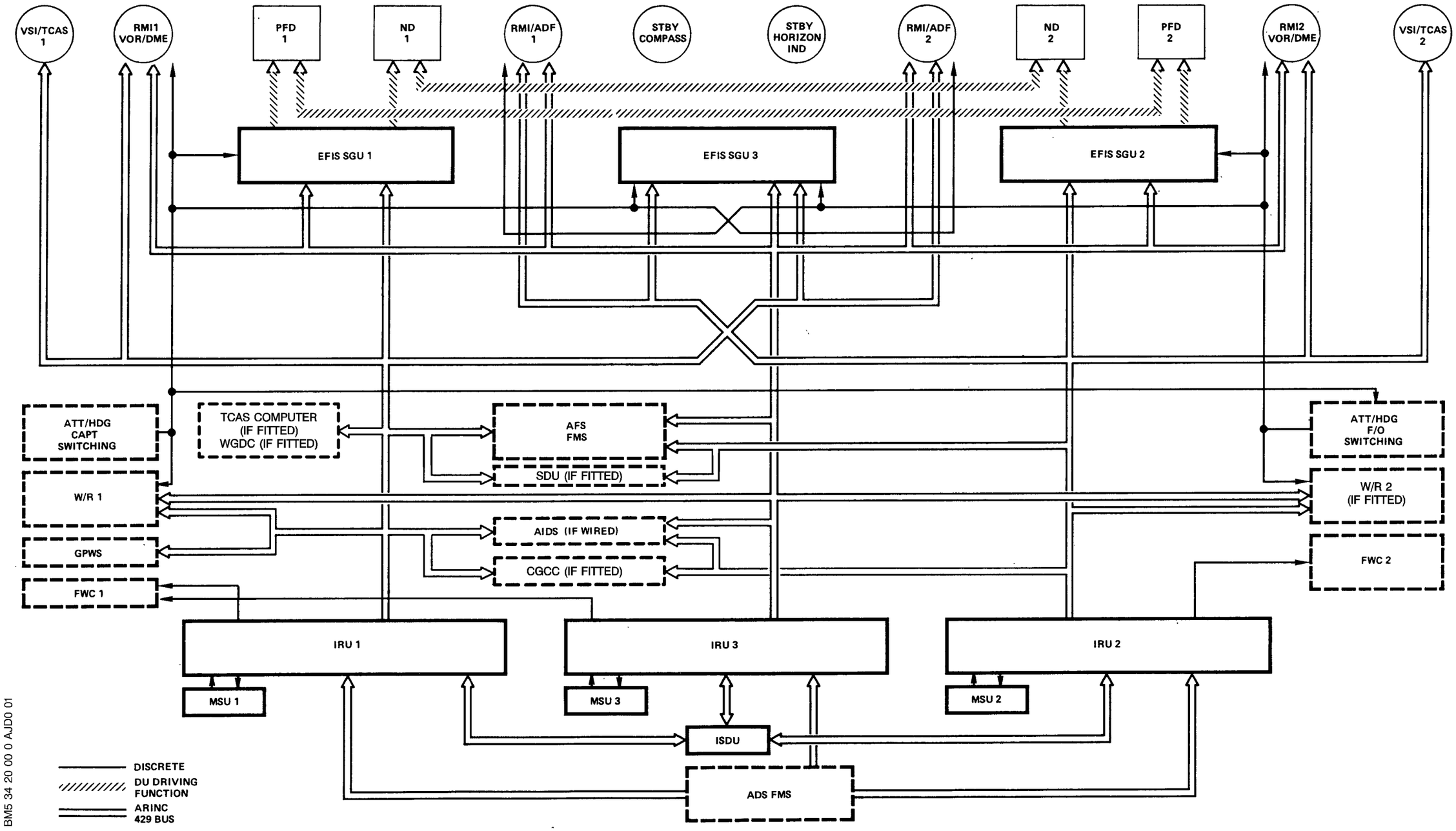
The F/O VOR/DME RMI recopies data from the IRS2

The F/O ADF RMI recopies data from the IRS1

The reconfiguration which enables the IRS1 or the IRS2 to be replaced by the IRS3 operates simultaneously for the attitude and the magnetic heading in the instruments using it : EFIS SGU1, 2, 3 and VOR/DME RMI, ADF RMI.



Attitude and Heading Reference System - Block Diagram
Figure 007



BM5 34 20 00 0 AJD0 01

Attitude and Heading Reference System - Block Diagram
Figure 008

(4)Heading data : standby system
This data is displayed by the standby compass which is an independent instrument of compass type.
(5)Other data displayed by the instruments

**ON A/C 001-003,

(a)On the Captain's main instrument panel, the Captain vertical speed indicator displays the inertial vertical speed generated by the IRS1 using acceleration detections and altitude data given by the associated ADC.
On the First Officer's main instrument panel, the First Officer vertical speed indicator displays the inertial vertical speed generated by the IRS2.

**ON A/C 004-200,

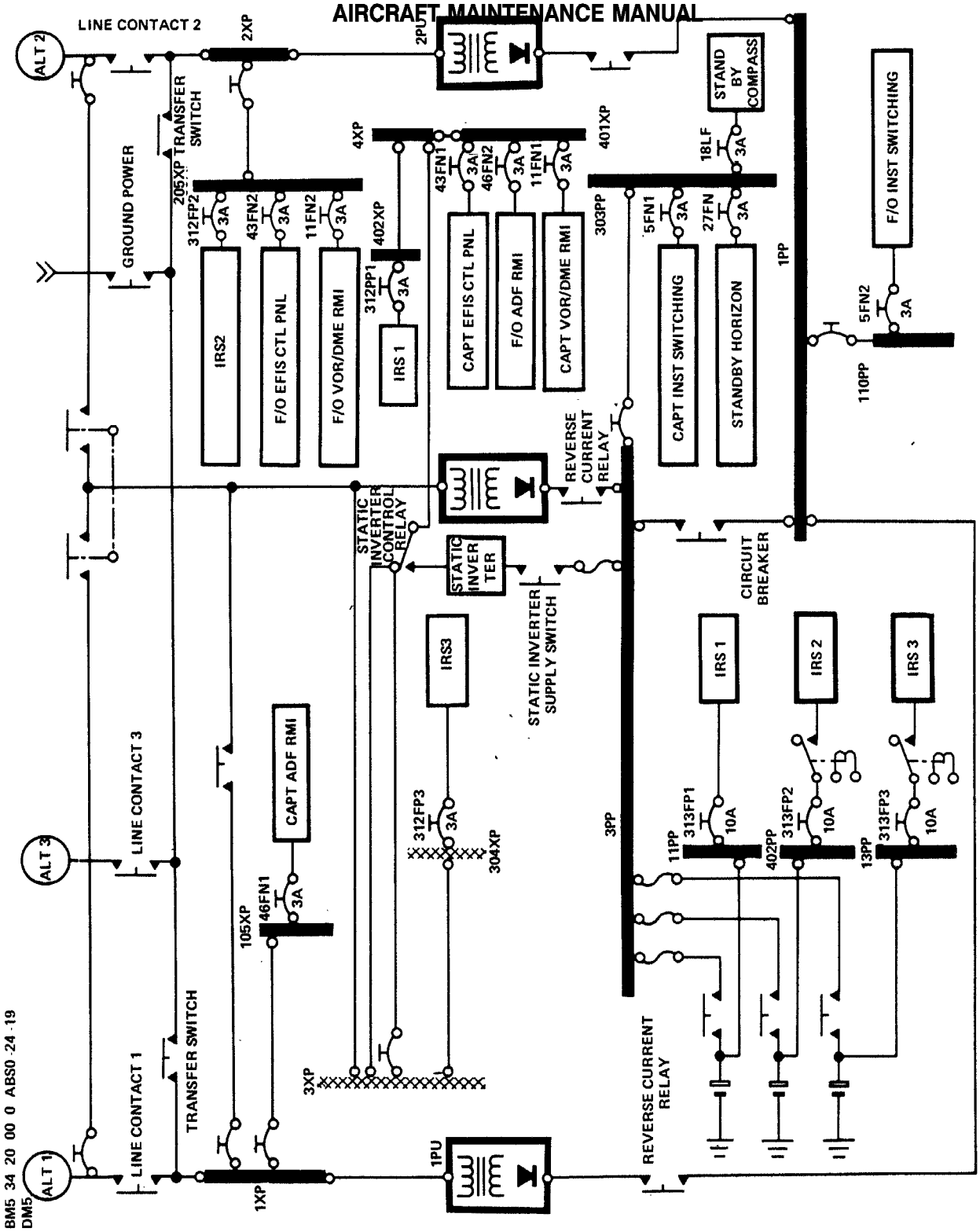
(a)On the Captain's main instrument panel, the Captain VSI/TCAS indicator displays the inertial vertical speed generated by the IRS1.
On the First Officer's main instrument panel, the First Officer VSI/TCAS indicator displays the inertial vertical speed generated by the IRS2.

**ON A/C ALL

(b)The EFIS instruments display the following data generated by the associated IRS's :
1 On the PFD :
- the aircraft transversal acceleration
- the flight path slope (in flight path vector mode)
2 On the ND :
- the ground speed
- the wind speed

B. Data Provided to Other Systems.
The Inertial Reference data are transmitted to the following systems :
- Auto Flight System (AFS)
- Flight Management System (FMS)
- Flight Warning Computer (FWC)
- Weather Radar system
- Ground Proximity Warning System (GPWS)
- Digital Flight Data Acquisition Unit (DFDAU) (if wired)
- Data Management Unit (DMU) (if fitted)
- Windshield Guidance Display Computer (WGDC) (if fitted)
- Center of Gravity Control Computer (CGCC) (if fitted)
- Traffic Collision Avoidance System (TCAS) (if fitted)
- Satellite Data Unit (SDU) (if fitted).

C. Power Supply
(Ref. Fig. 009)



Power Supply Diagram
Figure 009

R **ON A/C ALL

R Post SB 34-2208 For A/C ALL

R (Ref. Fig. 010)

R **ON A/C ALL

(Ref. Fig. 011)
Each IRS (comprising IRU, MSU, ISDU) is supplied by a 115VAC 400Hz voltage and by a 28VDC voltage provided by aircraft batteries.
The system is normally supplied with 115VAC.
In the event of a 115VAC power cut off, the system is automatically supplied by the 28VDC battery voltage which does not interrupt when loads are transferred to the aircraft electrical network. The power dissipation is as follows :

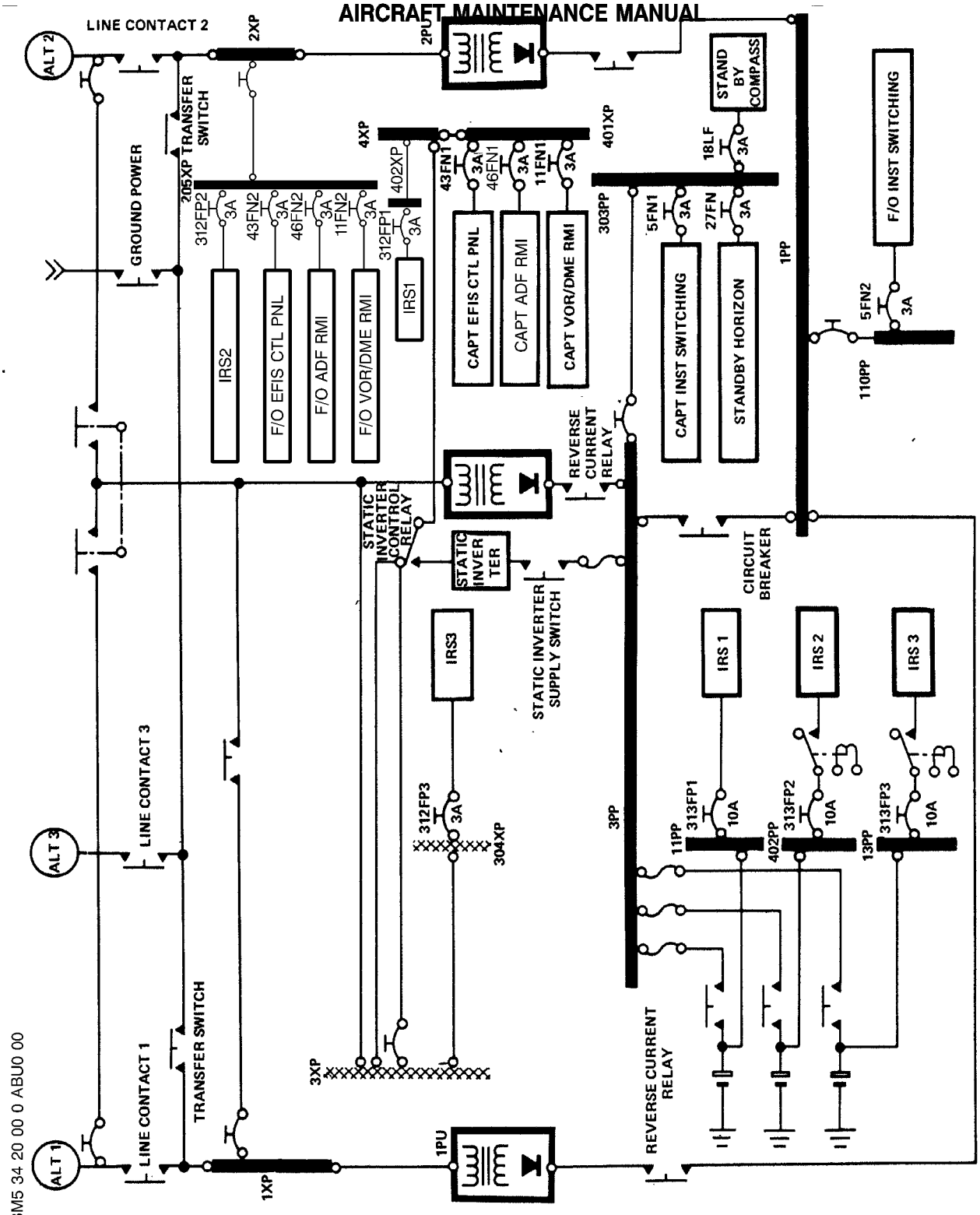
	115VAC/28VDC	5VAC
IRU/MSU	110	1.2
ISDU	15	2.6
TOTAL	125 watts	3.8 watts

NOTE : In the event of a 115VAC power cut off on ground, horn sounds and IRS RACK VENT warning light comes on after 10 seconds delay.

(1)IRS power supply distribution
The IRS1 is supplied by an ultimate emergency busbar with 115VAC and in ultimate emergency configuration is still supplied with 28VDC power supply from aircraft battery. With regard to ultimate emergency electrical loads balance, only the IRS1 remains supplied under these conditions. The IRS3 is supplied by a 115VAC essential busbar. In ultimate electrical emergency configuration the IRS3 is normally load shed when 115VAC and 28VDC power supply is interrupted. The 28VDC power supply is load shed by a relay supplied by the DC ESS BUS/SMOKE DRILL busbar after 30 seconds delay. Nevertheless if the Captain has previously selected the IRS3 (case of IRS1 failure) the 28VDC power supply is maintained in ultimate emergency configuration by means of the relay 13FN1.
The IRS2 is supplied by a 115VAC normal busbar. In ultimate electrical emergency configuration, the IRS2 is load shed when 115VAC and 28VDC power supply is interrupted. The 28VDC power supply is load shed by a relay supplied by the DC NORM busbar after 30 seconds delay.

(2)Smoke procedure
In the event of a smoke procedure, the configuration is the same as for the ultimate electrical emergency ; the IRS1 and, in the case of IRS3/IRS1 switching, the IRS3 are still supplied.

D. System Layout
The inertial reference units are installed in a special rack located in the



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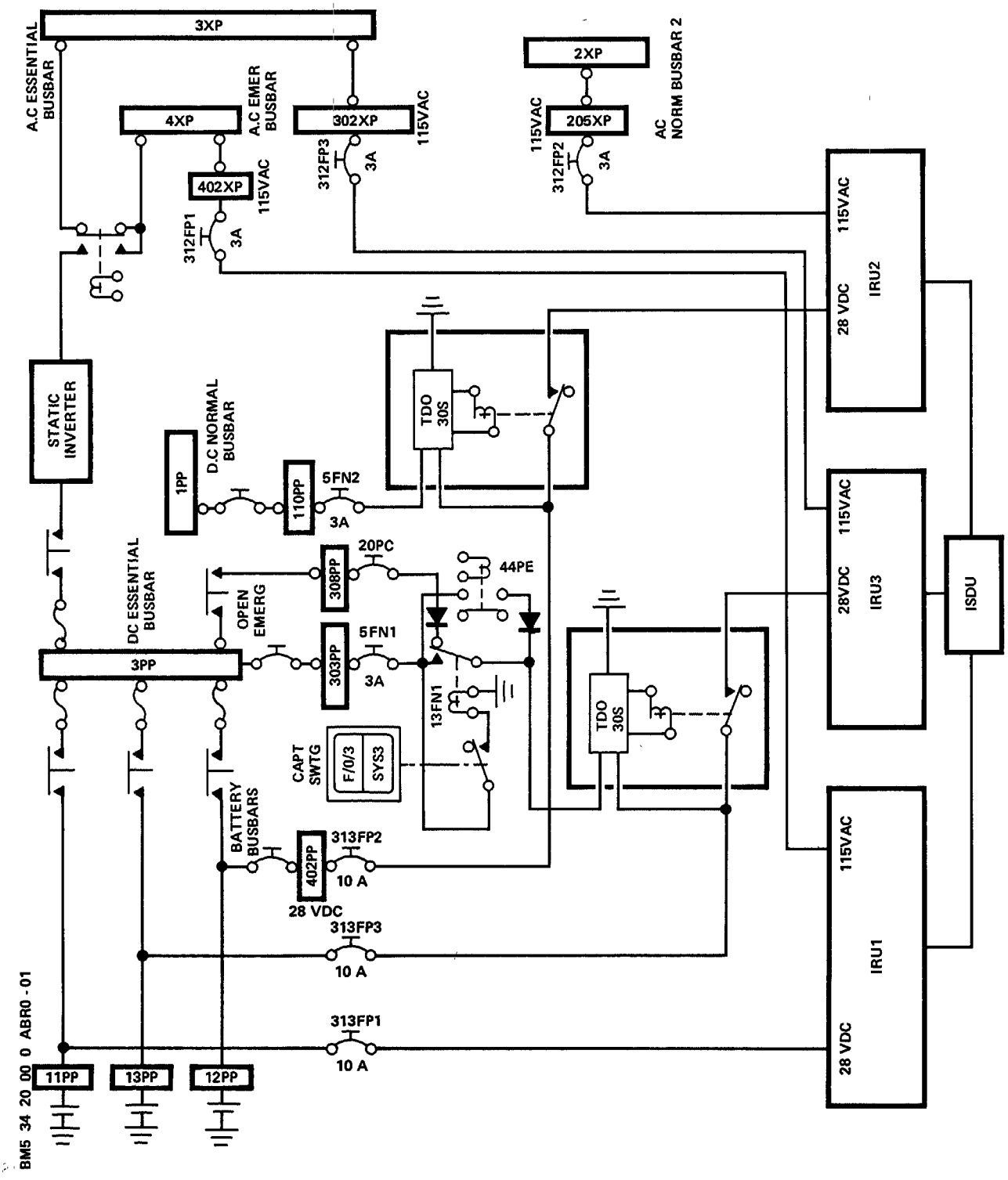
Power Supply Diagram
Figure 010

R



IRS Power Supply Distribution
Figure 011

aircraft avionics compartment, on LH side.
Two superposed shelves fitted with an ARINC 600 ventilation support IRU1 and IRU3 (upper shelf) and IRU2 (lower shelf) systems.
The upper shelf is sealed by closing panels for systems 1 and 3 are supplied by the aircraft electrical network in the case of a smoke procedure. The system longitudinal axis is parallel to the aircraft longitudinal axis, with the IRU handles oriented forward.
The IRU are attached to their racks by using 3 centering pins which enable an IRU/rack accurate alignment.
The IRU racks are adjusted to coincide with the 3 aircraft axes with an accuracy better than ± 10 arc. minutes.

NOTE : In the event of IRS ventilation failure on ground (distribution or extraction) IRS RACK VENT warning lights come on and horn sounds.

4. Component Description

A. Main Systems

The A/C system is made up of the following components :

Inertial reference unit : three units
Mode selector unit : three units
Inertial sensor display unit : 1 unit

These components are electrically linked.

(1)Inertial reference unit

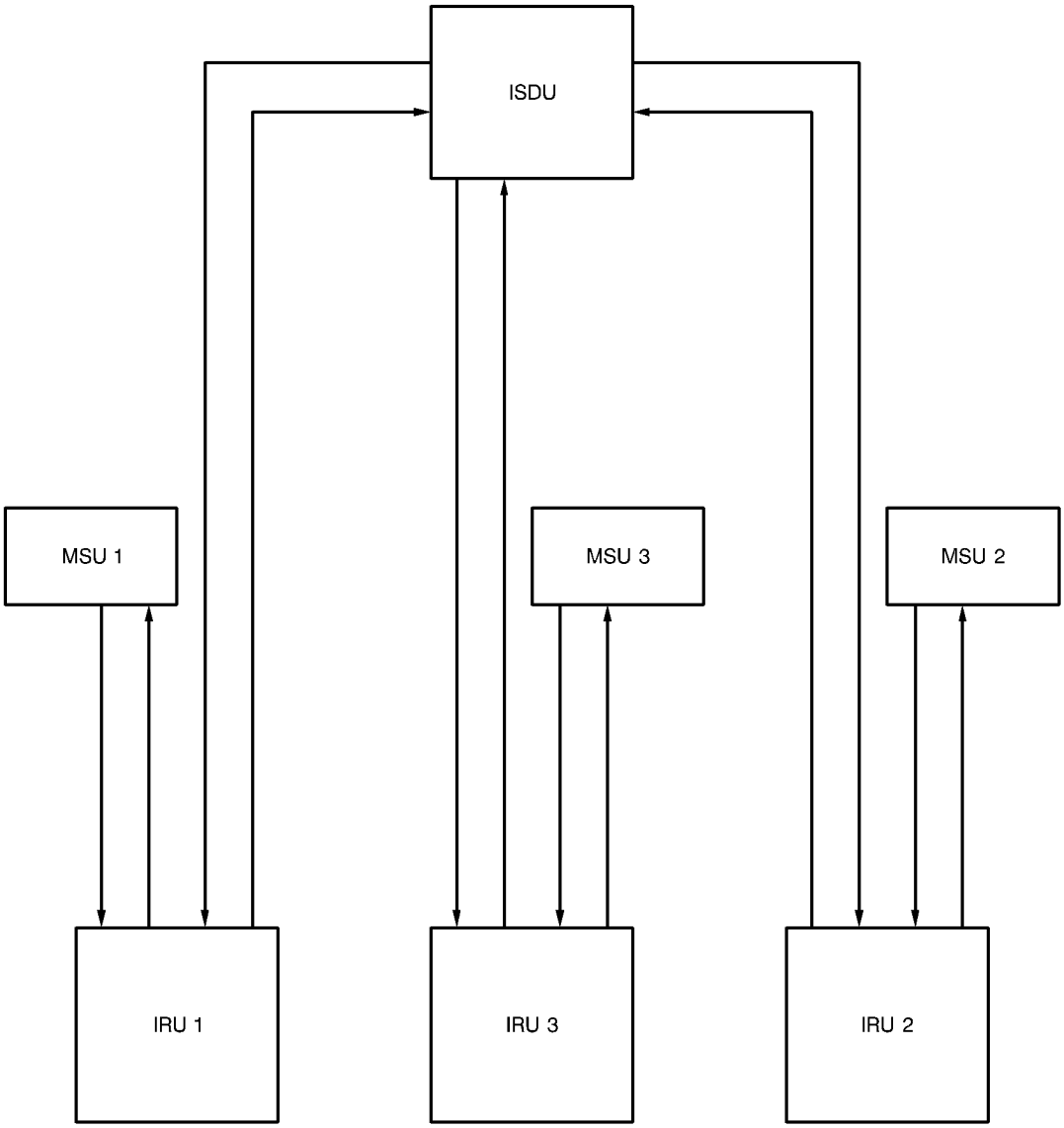
(Ref. Fig. 012)
(Ref. Fig. 013)
(Ref. Fig. 014)

The IRU is the system main unit. It is made up of an ARINC 600 type electronic unit.

Outside the gyros and accelerometers, the IRU contains power supplies and eight cards of electronics for sensor signal conditioning, data handling, timing and control, data processing, and system interface.

(a)Design characteristics

- SENSOR ASSEMBLY : the inertial sensor assembly consists of three Ring LASER Gyros, three accelerometers, a high voltage power supply, and PROM memory containing the sensor calibration coefficients.
  The Ring laser Gyro is an angular rate sensor. It uses counter rotating light beams to measure angular rotation. The beams are produced by a laser, and contained in an enclosed triangular optical cavity.
  The accelerometer employs a pendulum to detect accelerations.
- MICROPROCESSOR AND MEMORY : the microprocessor is the IRU central unit.
  Three types of memory are used in the IRU computer : RAM for data storage, EPROM for program storage, Non-volatile memory for power-down data storage.
- ACCELEROMETER AND GYRO ELECTRONICS : these two cards interface inertial sensor signals to the system bus.
- ANALOG-TO-DIGITAL CONVERTER MULTIPLEXER : the inputs to the card are basic inertial sensor signals and secondary sensor signals : sensor temperatures, gyro dither, pathlength control, and laser intensity. These signals are converted to digital words. Then, this card selects continuously the data required for the processing.
- INPUT AND OUTPUT ELECTRONICS : these two cards interface all input and output discretes and bus signals with the IRU internal bus system. The main components are five ARINC 429 receivers, three ARINC 429 transmitters, and interface components for discrete signals.
  The input card decodes the ARINC 429 input data and stores it in buffers directly accessible from the bus monitoring.
- BUILT-IN-TEST-EQUIPMENT (BITE) : The BITE electronics card interfaces with the bus system discrete signals for monitoring bus data and internal/external signals. Any abnormal operation is detected by the BITE electronics, and announced as required.
  The BITE electronics card includes a computer watchdog timer, non-volatile maintenance BITE memory, and drivers for the "Fault Ball".



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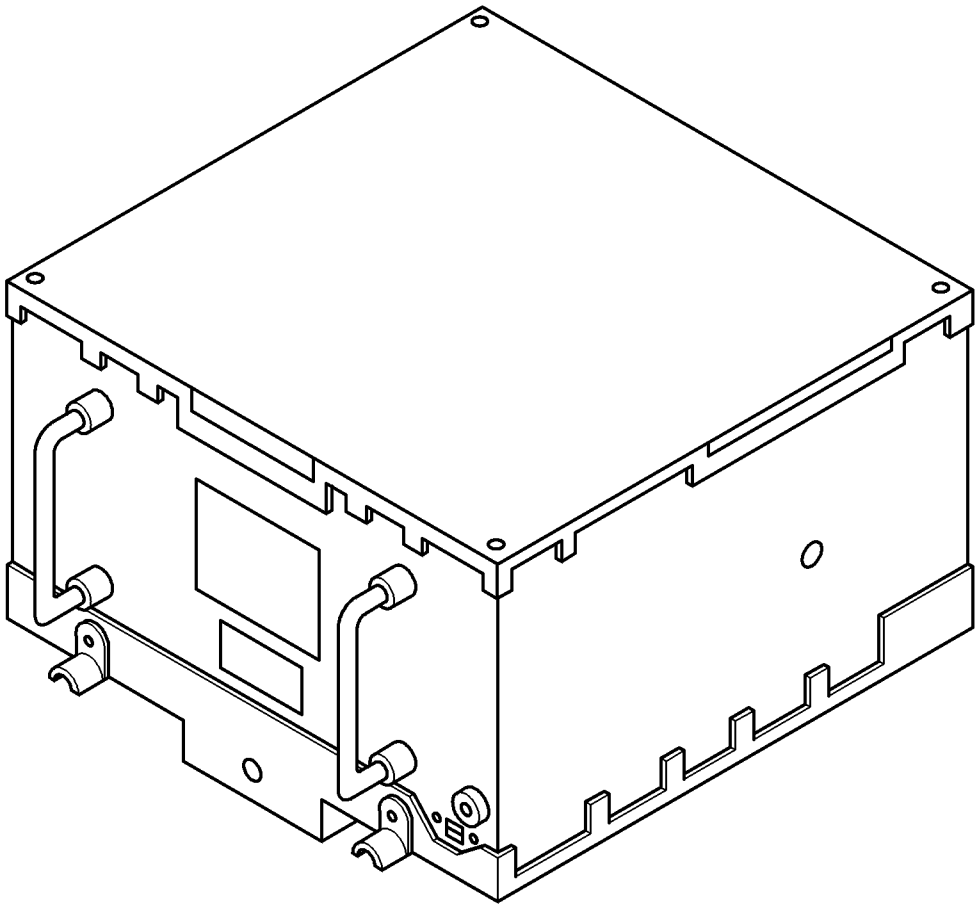
IRS - Components Linking
Figure 012



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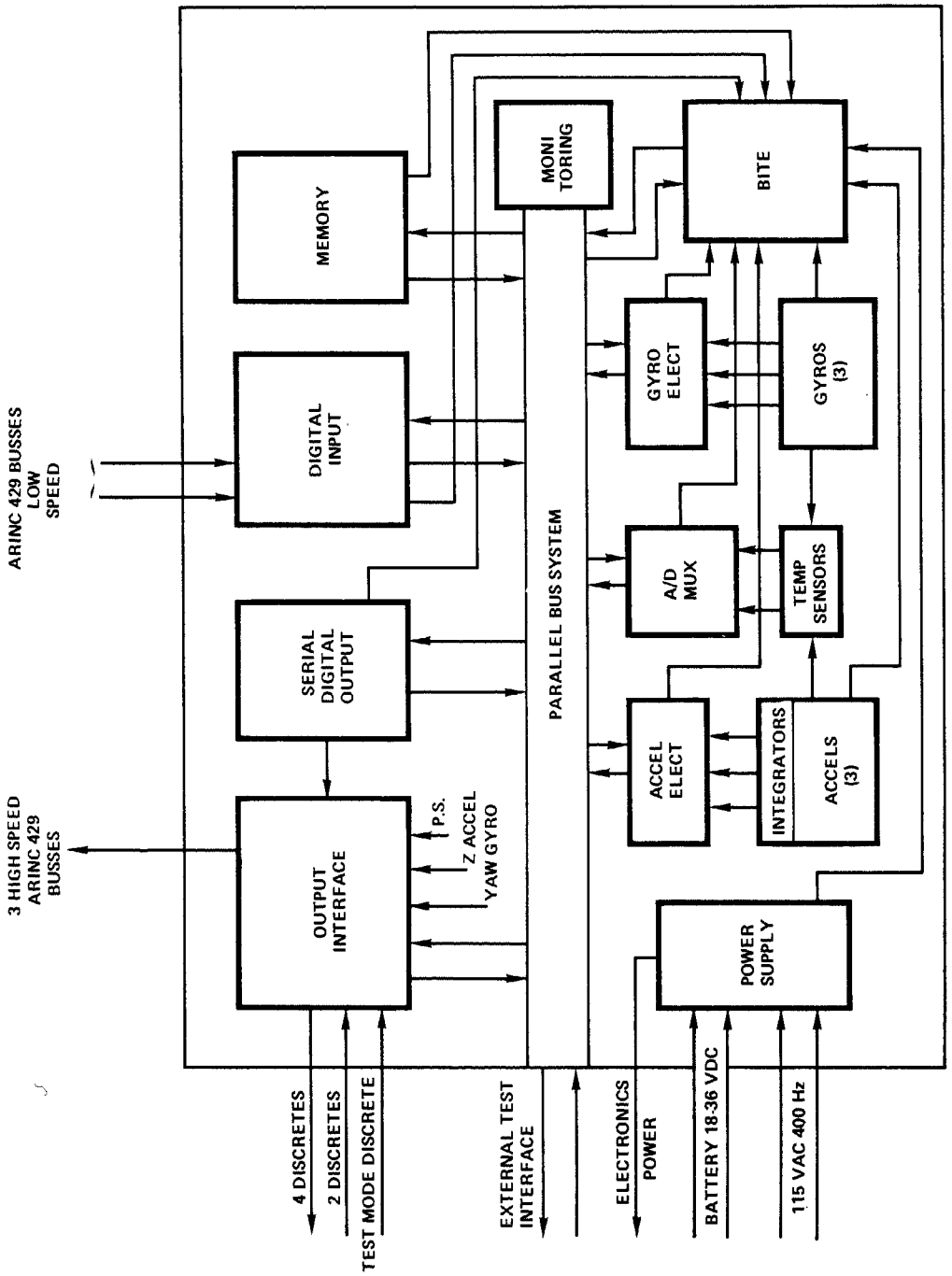
Inertial Reference Unit
Figure 013



Inertial Reference Unit - Block Diagram
Figure 014

- POWER SUPPLIES :
  There are two power supply assemblies : one develops the voltages used in the digital and analog processing electronics. It converts 115VAC 400 Hz single-phase power to all of the necessary regulated voltages required to operate the internal electronics of the IRU. The other is a high-voltage supply for LASER gyro excitation and dither.

(b)Operation

The inertial reference system operation consists in measuring aircraft rotations and accelerations around the three axes by means of gyrometers and accelerometers and in deducing aircraft speeds and position at any moment. For this purpose it is necessary to know the start position, and to perform an alignment in order to initialize computatations. The attitude primary data are thus the roll, pitch and yaw angular rates. Roll, pitch and heading are obtained by integration.

1 Navigation mode functions (Ref. Fig. 015, 016)

The navigation mode is the primary operating mode for the IRS and is implemented in software as unaided strapdown inertial navigation computation.

The functional operations executed by software to compute the required IRU outputs are :

- Attitude integration
- Body rotation rates
- Navigation frame inertial rotation rates
- Velocity integration
- Body accelerations
- Acceleration vector transformation
- Coriolis, gravity acceleration and vertical velocity
- Position integration
- Navigation frame rotation rate with respect to Earth

2 Alignment submode functions (Ref. Fig. 017)

The alignment submode is the principle initialization mode for the IRS.

Its primary function is to initialize the attitude, velocity, and position integration functions implemented in the navigation mode.

3 Attitude mode functions (Ref. Fig. 018, 019)

The attitude mode provides a backup reversionary capability in the event that system operation is required without completing a successful alignment (e.g. for an in-air start-up).

The primary function of this mode is to provide the flight critical outputs from the IRU.

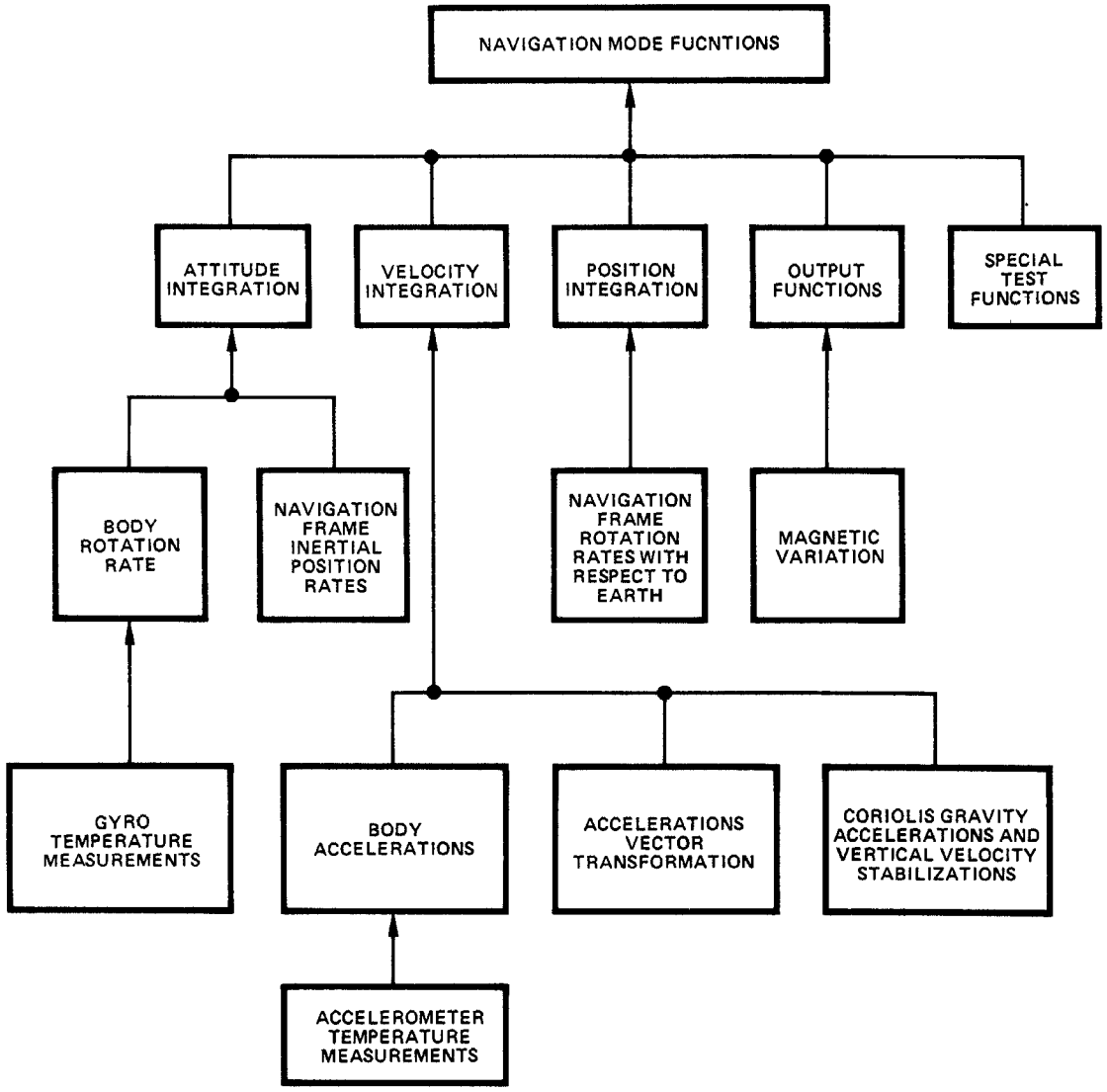
The B basic attitude mode operating elements consist of two integration functions : attitude and velocity driven by input gyro and accelerometer sensor data.

(2)Mode Select Unit (Ref. Fig. 020)

The mode select unit (MSU) is designed to interface with one IRU.

It is used to command the modes of operation with the mode selector knob :

- OFF MODE : All the circuitry is deenergized.
- NAV MODE : Normal position for IRS operation.
- ATT MODE : Selection of this mode when the alignment is not complete.



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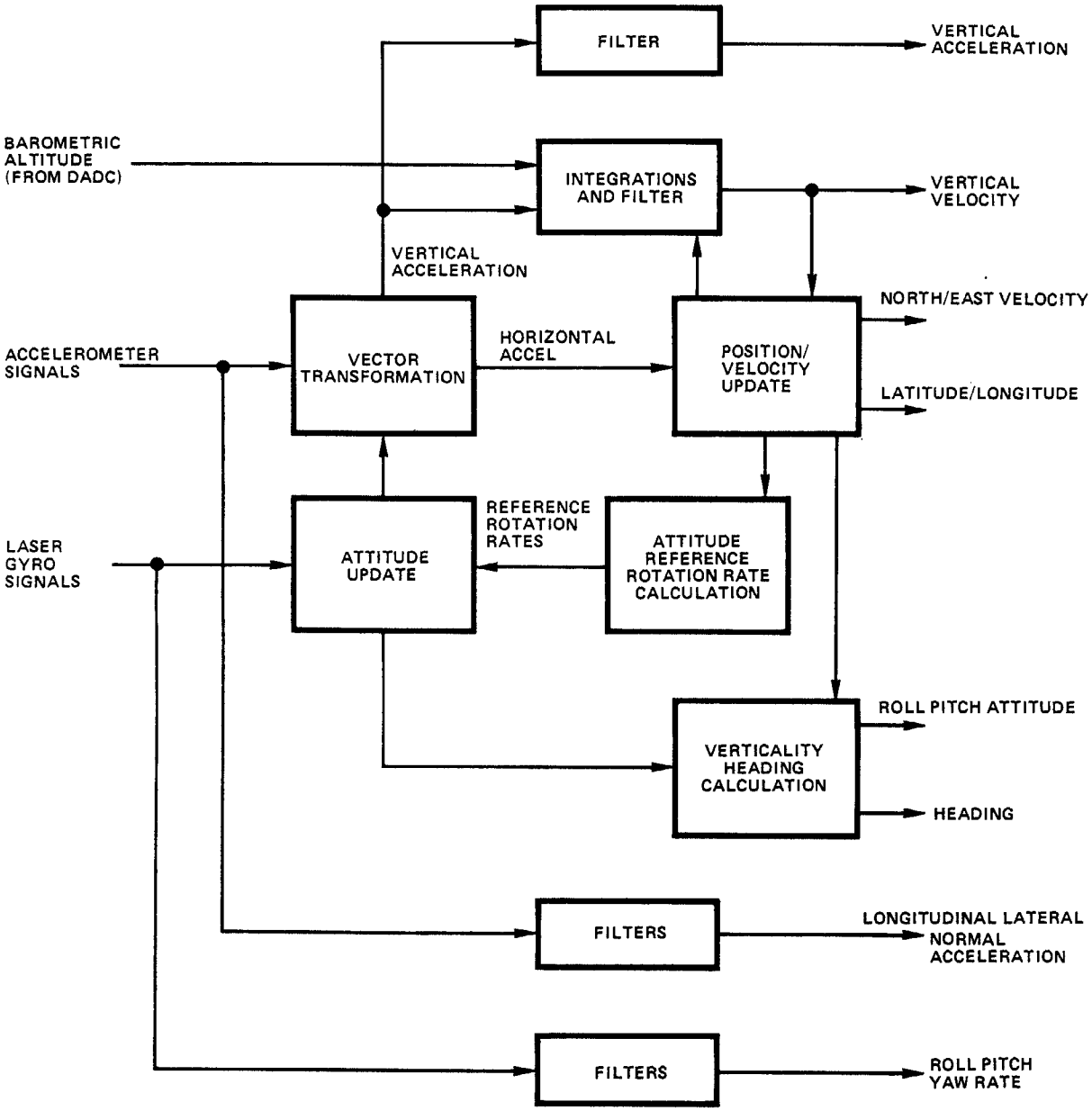
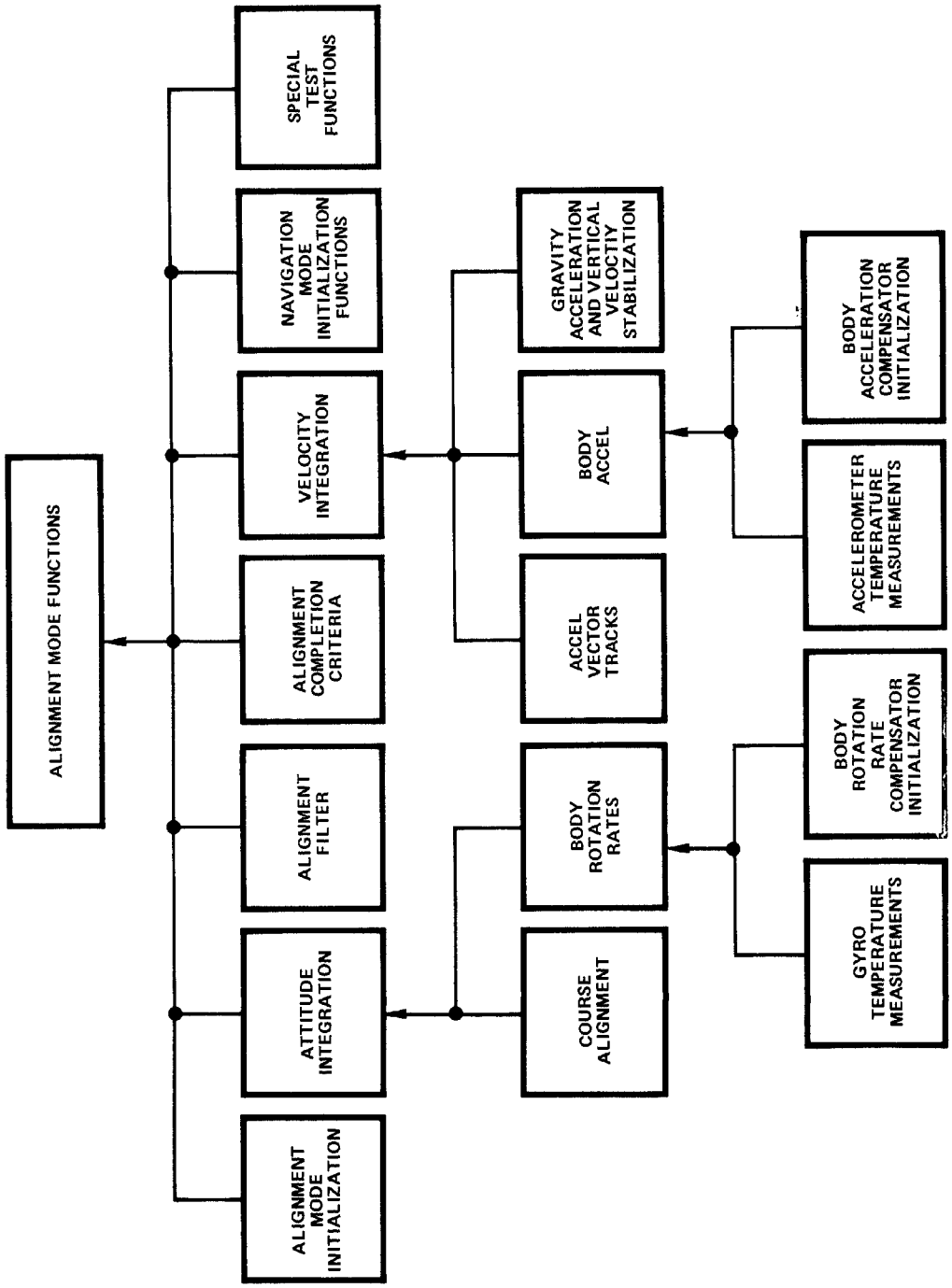
Navigation Mode Functions
Figure 015



Basic Navigation Mode Operations
Figure 016



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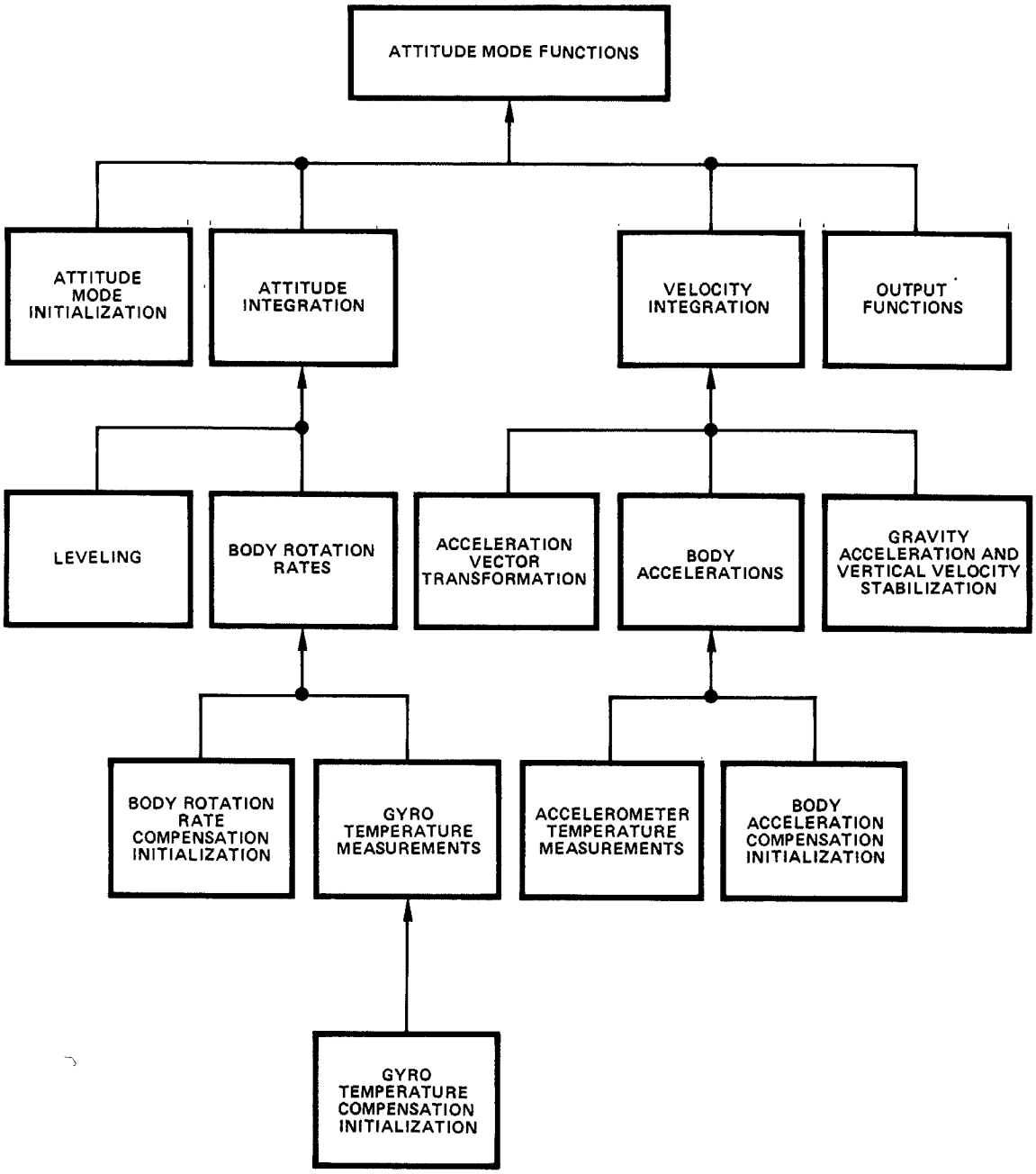
Alignment Submode Functions
Figure 017



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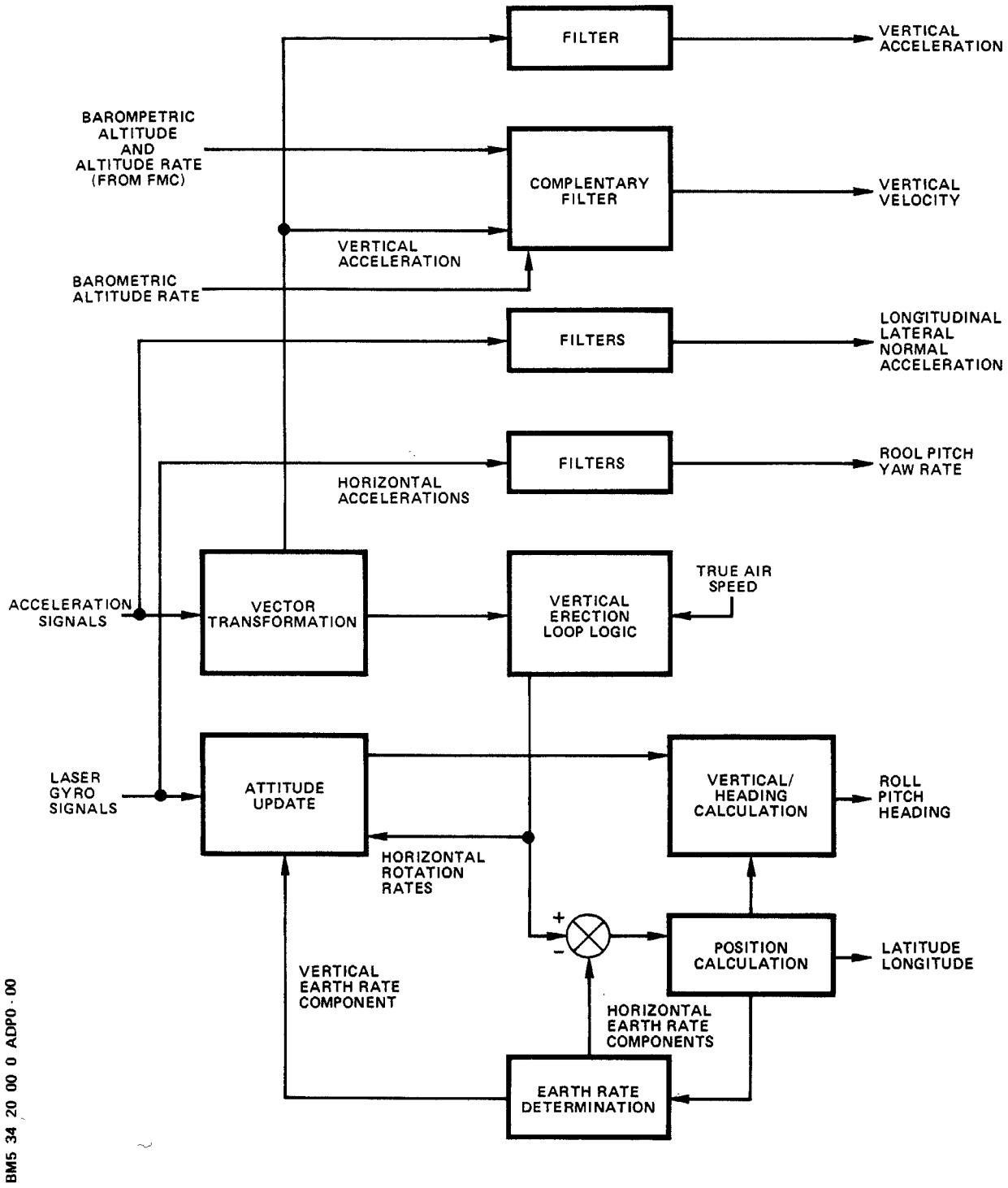
Attitude Mode Functions
Figure 018



Attitude Mode Operations
Figure 019

Only attitude and heading information is usable. The MSU is also used to annunciate status of the IRU.

The four standard aircraft word indicators (amber) on the front panel are :

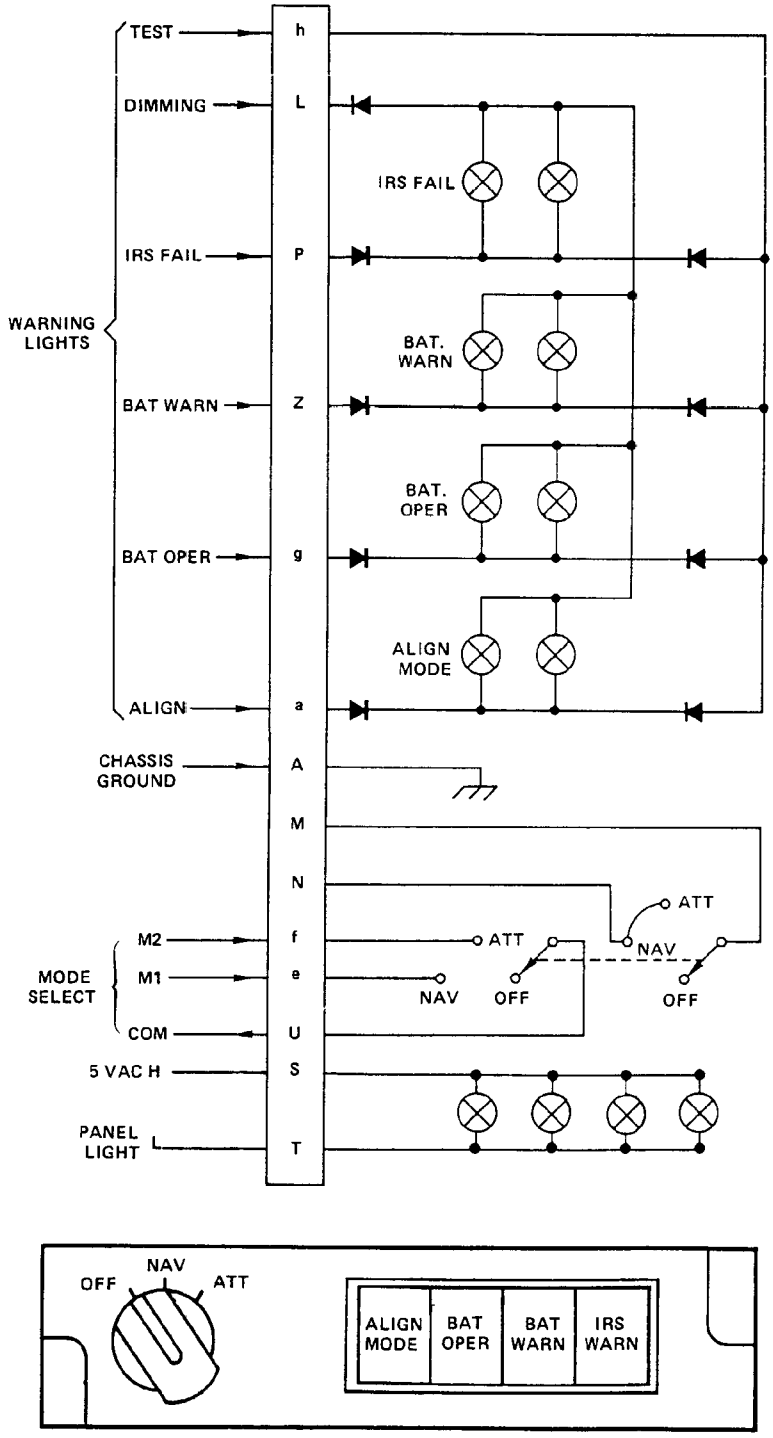
- **ALIGN MODE** : shows when the IRS is in the Alignment Mode. It comes on five seconds after system turn-on, and goes off normally ten minutes after system turn-on. It also comes on during the three-minutes realignment. A flashing light indicates an error in system initialization.
- **BAT OPER** : indicates that 28 VDC backup power is being used (aircraft batteries). It comes on also for the first five seconds after system turn-on. This annunciator is used to trigger an aural warning when the system is powered on ground with batteries only.
- **BAT WARN** : indicates that backup power is inadequate (battery voltage dropped to below 18 VDC).
- **IRS WARN** : shows a fault. A flashing light indicates a critical failure and that Attitude Mode may be selected.

(3)Inertial sensor display unit (Ref. Fig. 021)

The ISDU is connected to the 3 IRU and allows their initialization. It is also used to display the main navigation data such as present position, ground speed, true heading, wind information and system status. It is designed to interface with discrete and digital inputs received from each IRU. It can transmit discrete signals or digital messages to the three IRU. The ISDU consists of a front-panel mounted display, two selector knobs : SYS DSPL and DSPL SEL and a keyboard :

- **IRS DISPLAY** : The split display is used to display operator input data and selected information received from the IRU.
- **SYS DSPL** selector knob (system display selection) : selects the particular IRU (position 1, 2 or 3) from which the displayed data originates. When the selector knob is in the OFF position, the ISDU cannot receive data from any IRU though they still function.
- **DSPL SEL** selector knob (display selection) : has four positions by which data from the selected IRU may be displayed on the ISDU display. A fifth position is provided to check the display elements and keyboard cue lights. The five DSPL SEL switch positions and their related displays are as follows :
- **TEST** : (the DSPL SEL switch is spring loaded and must be held in this position). The ISDU display lights (all segments) and keyboard cue lights are energized to check for possible burned-out elements.
- **TK/GS** : Displays ground track direction in degrees on the left display, and ground speed in knots on the right.
- **PPOS** : Displays present position of the aircraft. Latitude on the left display and longitude on the right.
- **WIND** : Displays wind speed in knots on the right and wind direction in degrees on the left.
- **HDG/STS** : Displays true heading if NAV Mode is selected, or aircraft heading if ATT Mode is selected, on the left display and the alignment status on the right.

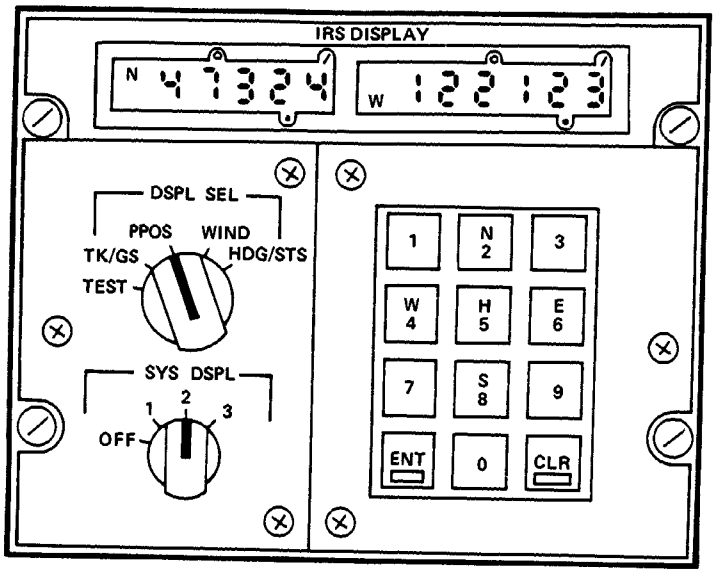
This unit is an emergency means for initialization display for these operations are normally performed through the Flight Management Systems. The FMS CDU allows the crew to program navigation functions



BM5 34 20 00 0 ADF0 01

Mode Selector Unit
Figure 020

and to display main navigation parameters.



BM5 34 20 00 0 ADGO - 09

Inertial Sensor Display Unit
Figure 021

B. Standby Systems

(1)Standby horizon indicator

(Ref. Fig. 022)

(a)General

This indicator is contained in a 3 ATI-S case and is supplied from emergency 28VDC.

It provides the following data :

- roll angle
- pitch angle
- instrument failure (by means of a flag).

(b)Description

1 Pitch data

The pitch drum (1), which is visible in the center of the window, is divided into two color zones separated by a horizon datum line. The upper zone is blue and the lower zone is black.

The center part of the drum is graduated between +80° (nose-up) and - 60° (nose-down).

2 Roll data

The pitch drum (1) axis is linked to a pointer (2) which moves across a curved scale (3) graduated in 10° increments up to 60° on either side of the vertical reference line.

3 Warning

The warning flag (4) comes into view in case of failure of the electrical power supply.

The aircraft symbol (5) is fixed.

Fast resetting of the gyroscope can be achieved by pulling knob (6), without turning.

(c)Principle of operation

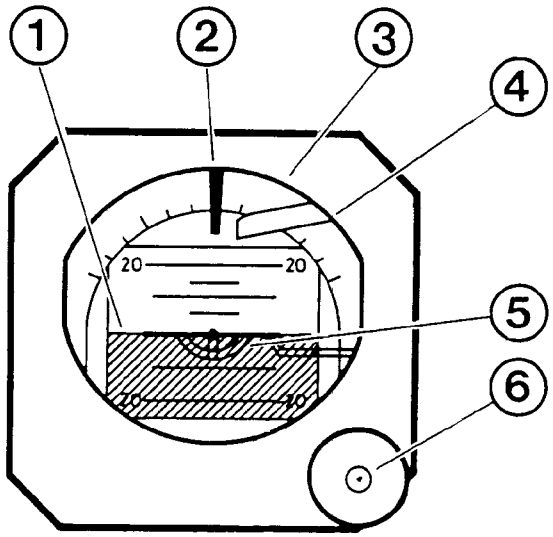
The attitude reference is provided by a gyroscope whose rotor revolves at 24,000 r.p.m. around its vertical axis. The gyroscope gimbal suspension pivots around two perpendicular axis (pitch and roll). The inner gimbal, which carries the stator, controls movement of the pitch drum through a gear train (stops limit movement to +85° and -85°).

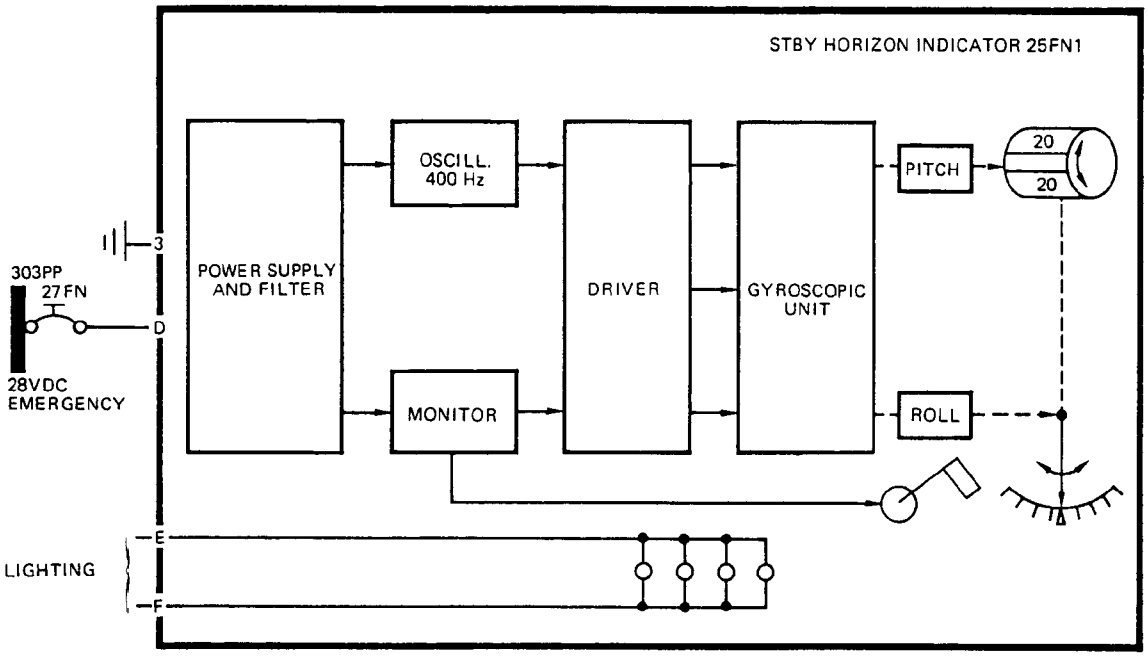
The outer gimbal controls movement around the roll axis.

The gyroscopic axis is maintained vertical by a mechanical erector device which is de-activated when the rotor axis deviates more than 10° from vertical axis.

The gyroscope is supplied with three-phase AC power through an internal static inverter which receives emergency 28VDC from the aircraft electrical network.

Internal monitoring detects any anomaly in gyroscope operation by checking the motor supply voltage.

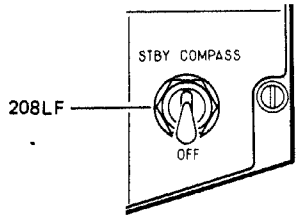


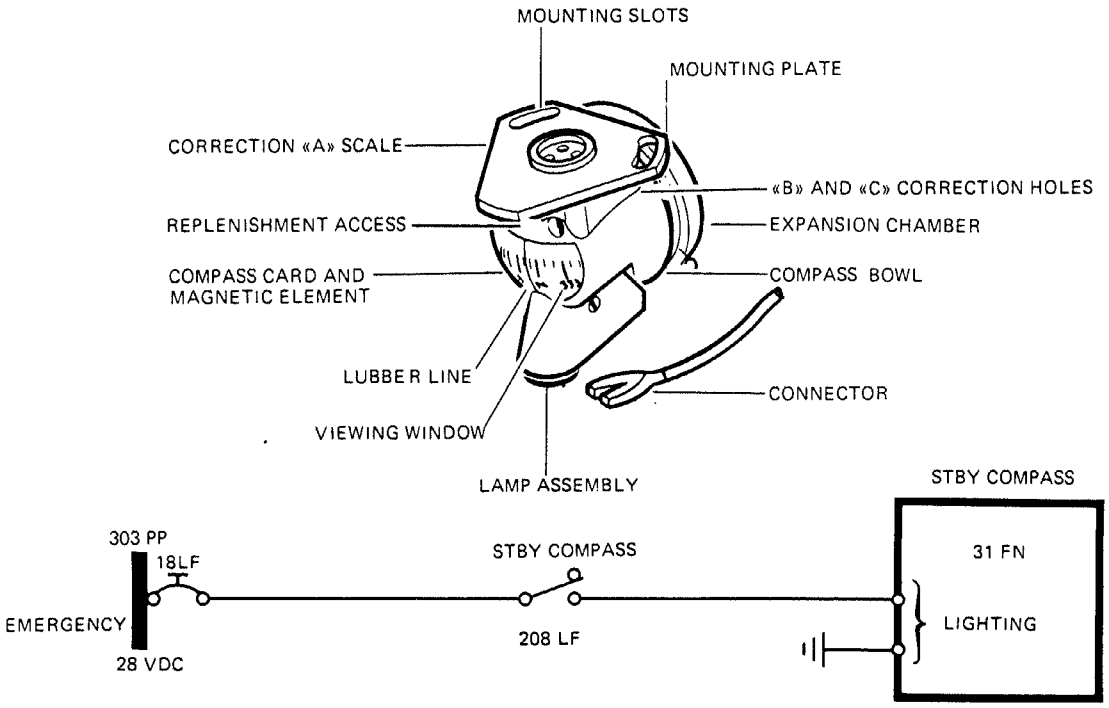


BM5 34 20 00 0 ADE0 02

Standby Horizon Indicator
Figure 022

(2)Standby compass
(Ref. Fig. 023)
The standby compass consists of a magnetic element free to rotate inside a compass bowl, immersed in a damping liquid. The magnetic element is linked to a compass card which moves against a lubber line and gives the magnetic heading.
The upper mounting plate has graduations which enable deviation A correction to be made by rotating the standby compass on its mounting screws. Below the mounting plate scale are two holes marked B and C,
R allowing by means of a special key located in the spare bulb box (Zone
R 210) to achieve compensation by positioning the two small magnetized
R bars (as per E-W and N-S axis).
The position of each bar is repeated by pointer indicators located on the top of the mounting plate.
A non-magnetic lamp assembly provides illumination of the heading dial from the lower part of the standby compass.





BM5 34 20 00 0 ADK0-09-04
DM5

Standby Compass
Figure 023

C. Radio Magnetic Indicators
(1)VOR/DME RMI

**ON A/C 001-100,

(Ref. Fig. 024)

**ON A/C 101-200,

(Ref. Fig. 025)

**ON A/C 001-100,

(a)General
This combined VOR/DME RMI indicator contained in a 4 x 3 ATI-S case with digital input (ARINC 429 bus type) uses IRS, VOR, DME and Flight control unit data to display the following parameters :
- magnetic heading
- VOR 1 and VOR 2 bearings
- DME 1 and DME 2 distances.
- selected heading
A microprocessor provides control and monitoring of each indication

**ON A/C 101-200,

(a)General
This combined VOR/DME RMI indicator contained in a 4 x 3 ATI-R case with digital input (ARINC 429 bus type) uses IRS, VOR and DME data to display the following parameters :
- magnetic heading
- VOR 1 and VOR 2 bearings
- DME 1 and DME 2 distances
Five microcomputers provide control and monitoring of each indication.

**ON A/C 001-100,

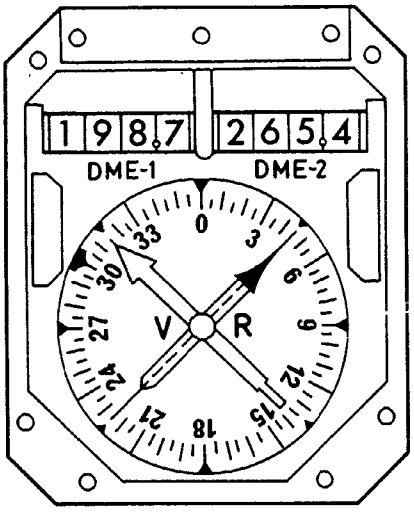
(Ref. Fig. 026).

**ON A/C 101-200,

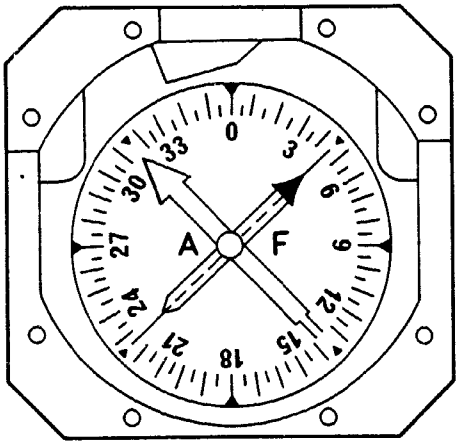
(Ref. Fig. 027)

**ON A/C ALL

The indicator consists of five digital channels ; an heading's one, two for bearings' ones and two DME's ones. It receives heading data, VOR bearings datas and DME datas wich are converted to a visual display of airplane magnetic heading, of VOR bearings and of DME distances.
The system integrity is constantly monitored by circuitry within the indicator.
The warning flags come into view when, there is a malfunction in their



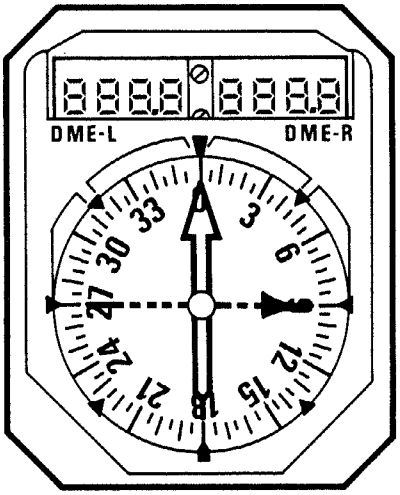
VOR/DME RMI



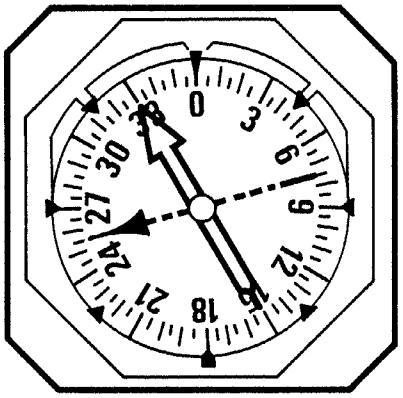
ADF RMI

BM5 34 20 00 0 AD00 10 05
DM5

Radio Magnetic Indicators
Figure 024



VOR/DME RMI



ADF RMI

BM5 34 20 00 0 ADH0-22

Radio Magnetic Indicators
Figure 025

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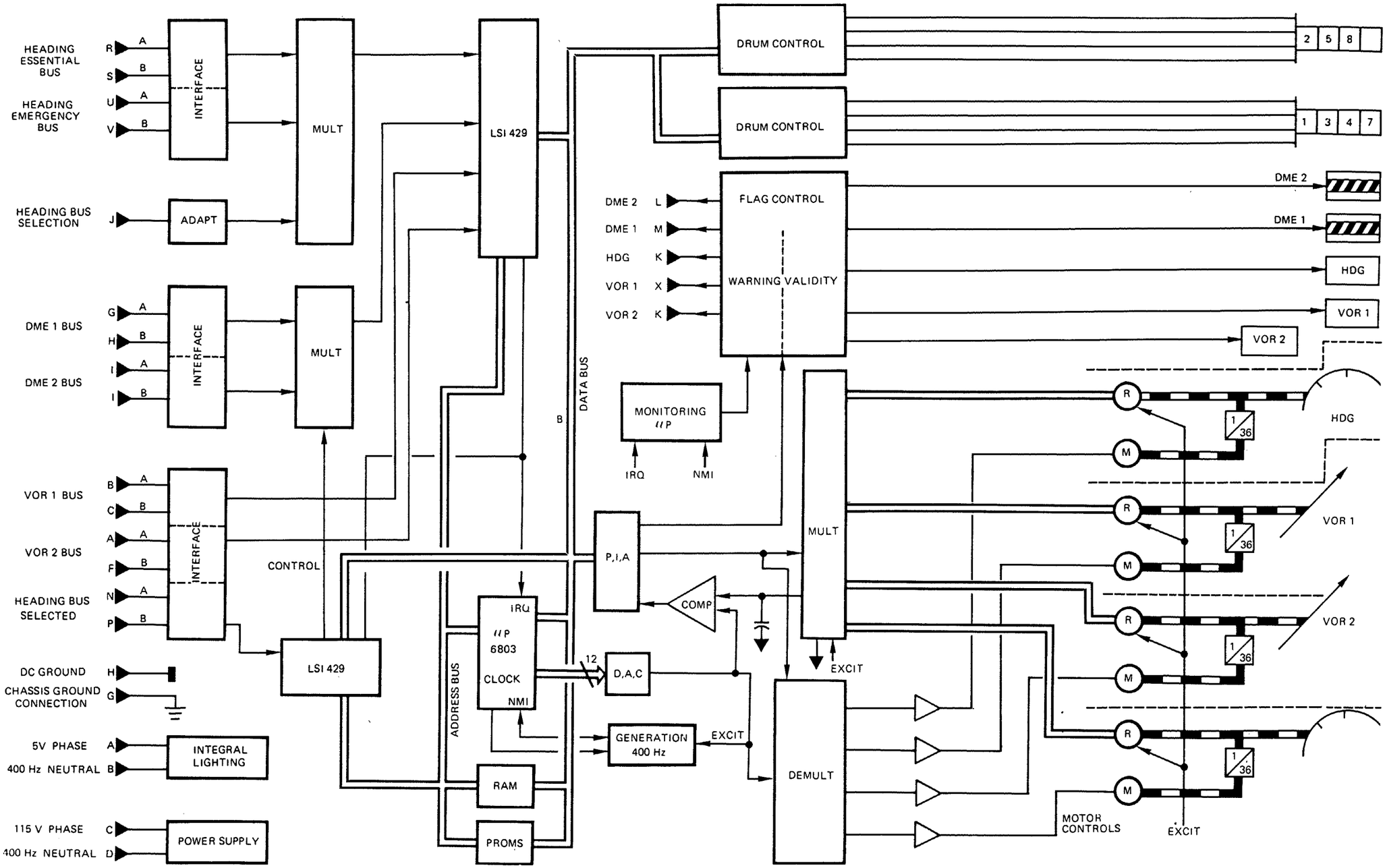
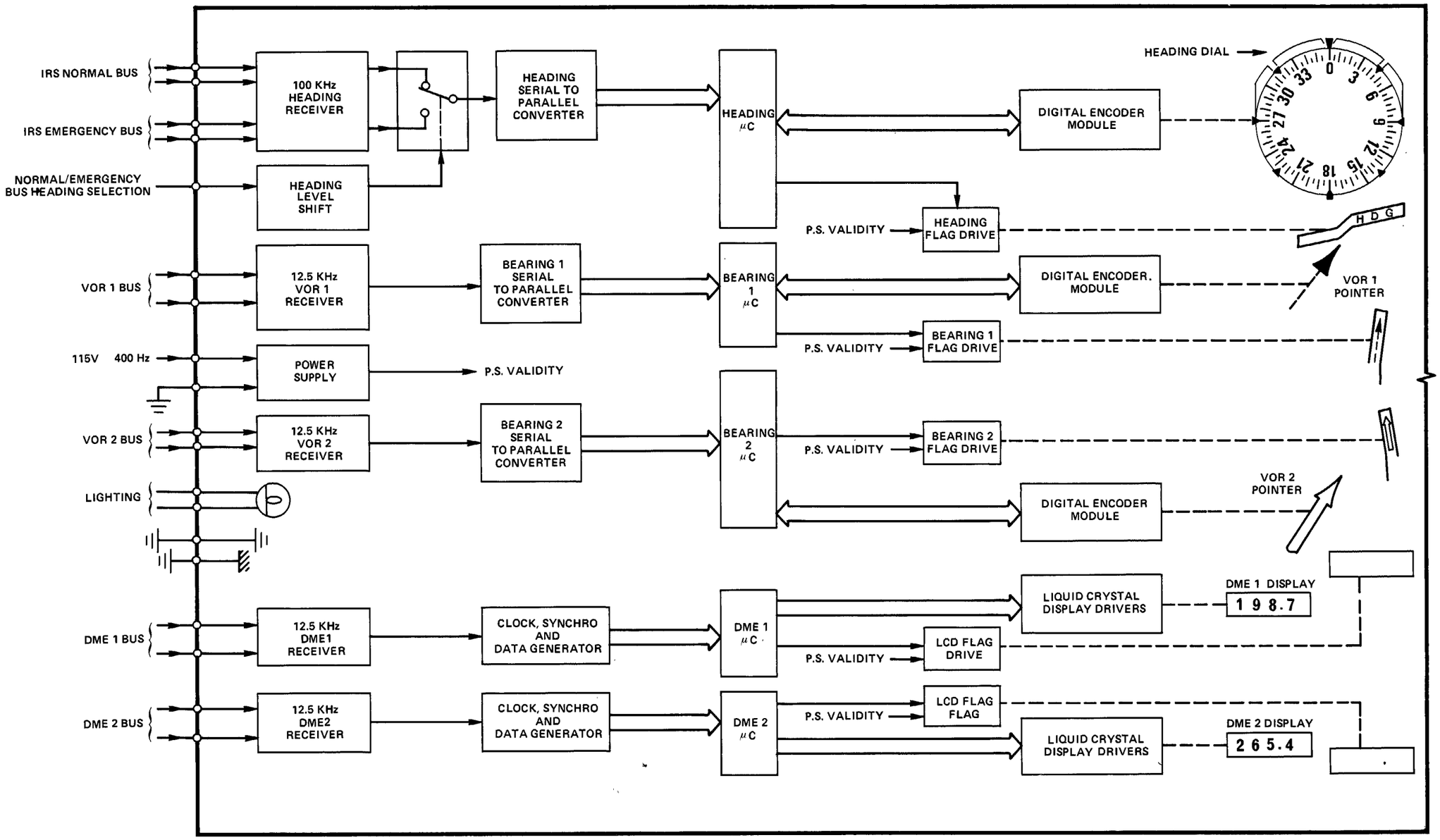


BM5 34 20 00 0 ADV0 09 04
DM5

VOR/DME RMI - Schematic
Figure 026



BM5 34 20 00 0 ADJ0-22

VOR/DME RMI - Schematic
Figure 027

respective channel.

**ON A/C 001-100,

(b)Operation of an analog format channel (Heading, selected heading, VOR).

1 Input data

The ARINC 429 digital data of
- heading (label 320) high speed bus
- selected heading (label 101) low speed bus
- VOR (label 222) low speed bus

is received on the input buses from
- the IRS for heading
- the VOR receiver for bearing
- the Flight control unit for the selected heading.

The signals are adapted and shaped so as to be transmitted to the LSI the function of which is to ensure the reception interface with the microprocessor of the digital processing unit.
The parameter value is converted into an input angular value which corresponds to the value of the electrical angle of a dummy resolver having the same scale factor as the output boostrap resolver. This angular value is converted into sine and cosine digital value.

2 Bootstrap data (output)

A resolver repeats the mechanical output of the display. The output electrical signals are generated from alternating 400 Hz voltage. These signals represent in amplitude and phase, the sine and cosine of the boostrap angle.
These voltages are multiplexed, sampled, then converted into digital values by an analog/digital conversion channel.

3 Computation of the angular error

The input sine/cosine digital angular values are compared with the output sine/cosine digital angular values (recopy). The error signal which is thus determined triggers the motor control order.
This control order is converted into a continuous signal by the digital/analog converter, then it is applied to the servomotor through a control circuit. The servomotor drives the display system (dial or pointers) and the bootstrap resolver until the error signal is inhibited (the output signal is then equal to the input signal).

(c)Operation of DME digital format channel

1 Input data

The ARINC 429 digital data from DME (label 201) is received on the low speed input buses from DME receiver.
This data is received in BCD form.
The signals are adapted for each of both buses and are then multiplexed to enable utilization of a single channel of LSI circuit the function of which is to ensure the interface with the microprocessor of the digital processing unit.

2 Message processing

The digital processing unit analyses the sign status matrix, checks the parity bit, then loads the selected channel buffer circuits with block of 8 bits representing two digits of DME display.

These circuits maintain data at the input of the display control hybrid circuits.

3 Display

The display control circuit transmits to each of the electromagnetic drums voltages required for their positioning.

(2)ADF RMI

**ON A/C 101-200,

(b)Operation of the heading and the two bearing

Each channel consists of a receiver, a serial to parallel converter, a microcomputer and a digital encoder module.

The ARINC 429 digital data of

- heading (label 320) high speed bus
- VOR (label 222) low speed bus

Vis received on the input buses from

- the IRS for heading
- the VOR receiver for bearing

Each indicator's receiver converts input signal from a ternary signal to a 32-bit serial data word. The heading converter selects primary or alternate heading logic. Each converter converts 32-bit serial data into 4-bit parallel data. Each microcomputer processes heading and bearing data into usable valid data and provides a servo-position signal to the digital encoder module. It monitors its own operation and valid data. Heading and bearing flags drop into view with any detected failure. Then each digital encoder module positions respectively the heading dial to the airplane heading and the two pointers to the selected bearings. These positions are encoded continually and these informations are used by the microcomputers to develop a new servo position.

(c)Operation of the two DME digital channels

Each channel consists of a receiver, a clock, synchro and data generators, a microcomputer, a liquid Crystal Display (LCD) driver and a liquid Crystal Display.

The ARINC 429 digital data from DME (lateral 201) interrogator is received on the low speed input buses from DME receiver.

The receiver converts DME signals from a ternary signal to a 32-bit serial data word. The clock, synchro and data generators convert 32-bit serial data into clock pulpes synchropulses and data. The microcomputer processes DME data into valid data and provides binary coded decimal data to the LCD driver.

It monitors its own operation and input data. The DME display blanks with any detected failure. The LCD drivers decode binary coded decimal data into segment data to be displayed by the liquid crystal displays.

(d)Power supply

The power supply converts 115VAC/400 Hz into +24 VDC, +12VDC, -12VDC, +5VDC -35VDC, VBP (Volts , back plane) and V SEG (Volts, segment).

The VBP and VSEG are OVDC and 30VDC square wases, 180° out of phase.

The +5VDC and ±12VDC are monitored by a power supply monitor and any detected failure will cause the heading and bearing warning flags to drop into view and DME display to blank.

(2)ADF RMI

**ON A/C 001-100,

(Ref. Fig. 024)

(a)General

This combined ADF RMI indicator contained in a 3ATI-S case, with digital input (ARINC 429 bus type) uses IRS and ADF data to display the following parameters :

- magnetic heading
- ADF 1 and ADF 2 bearings.

A microprocessor provides control and monitoring of each indication.

(b)Operation of an analog format channel (Heading, ADF)

**ON A/C 101-200,

(Ref. Fig. 025)

(a)General

This combined ADF RMI indicator contained in a 3.26 x 3.36 AT1-S, with digital input (ARINC 429 bus type) uses IRS and ADF data to display the following parameters :

- magnetic heading
- ADF 1 and ADF 2 bearings

Three microcomputers provide control and monitoring of each indication. The indicator provides a visual display of heading and ADF bearing stations. Failure warnings of input signals and self detected failures are displayed by flags.

(b)Operation of heading and ADF channels

**ON A/C 001-100,

(Ref. Fig. 028)

**ON A/C 101-200,

(Ref. Fig. 029)

**ON A/C 001-100,

The figure shows the ADF RMI block diagram :

1 Input data

The ARINC 429 digital data of :

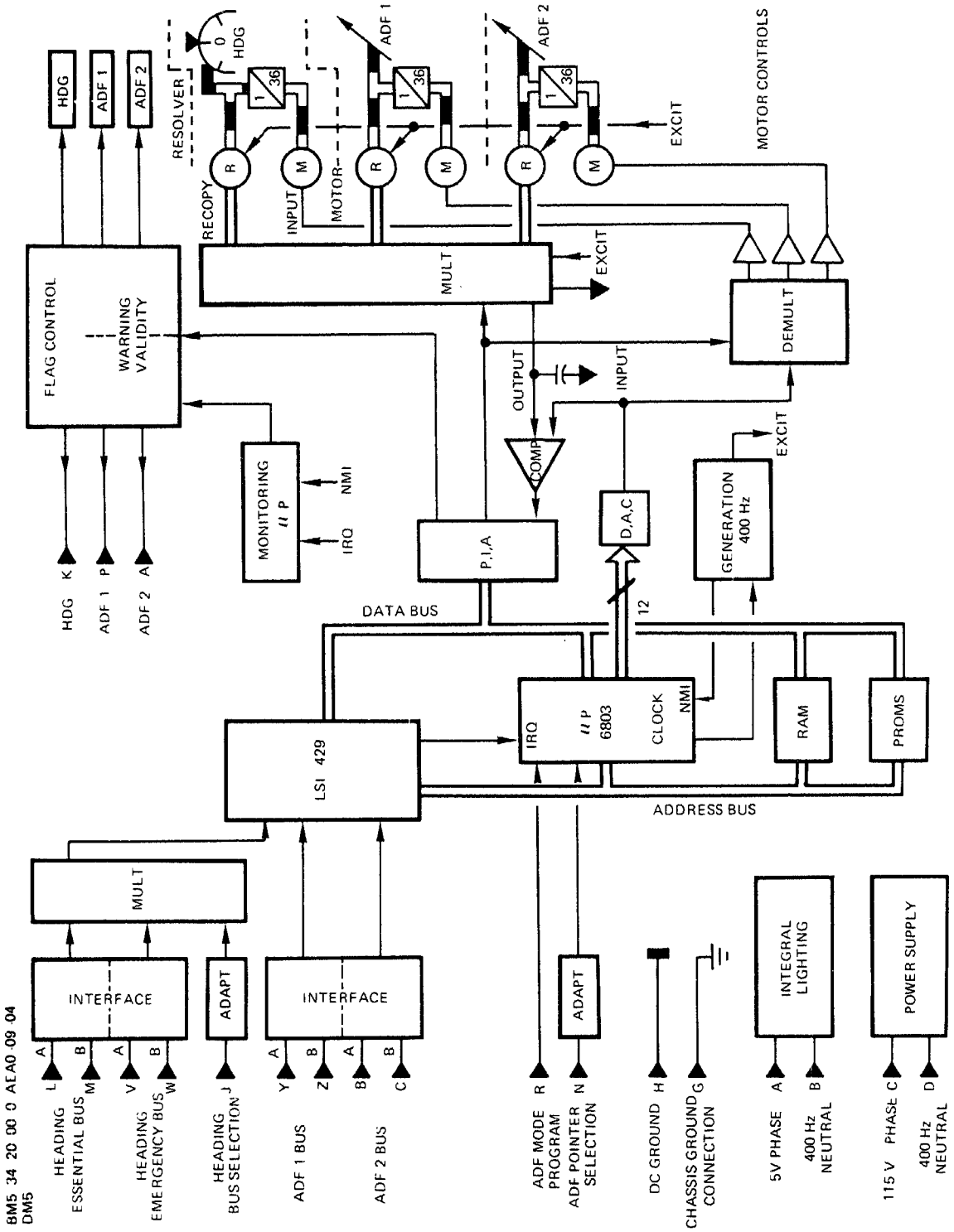
- heading (label 320) high speed bus
- ADF (label 162) low speed bus

is received on the input buses from :

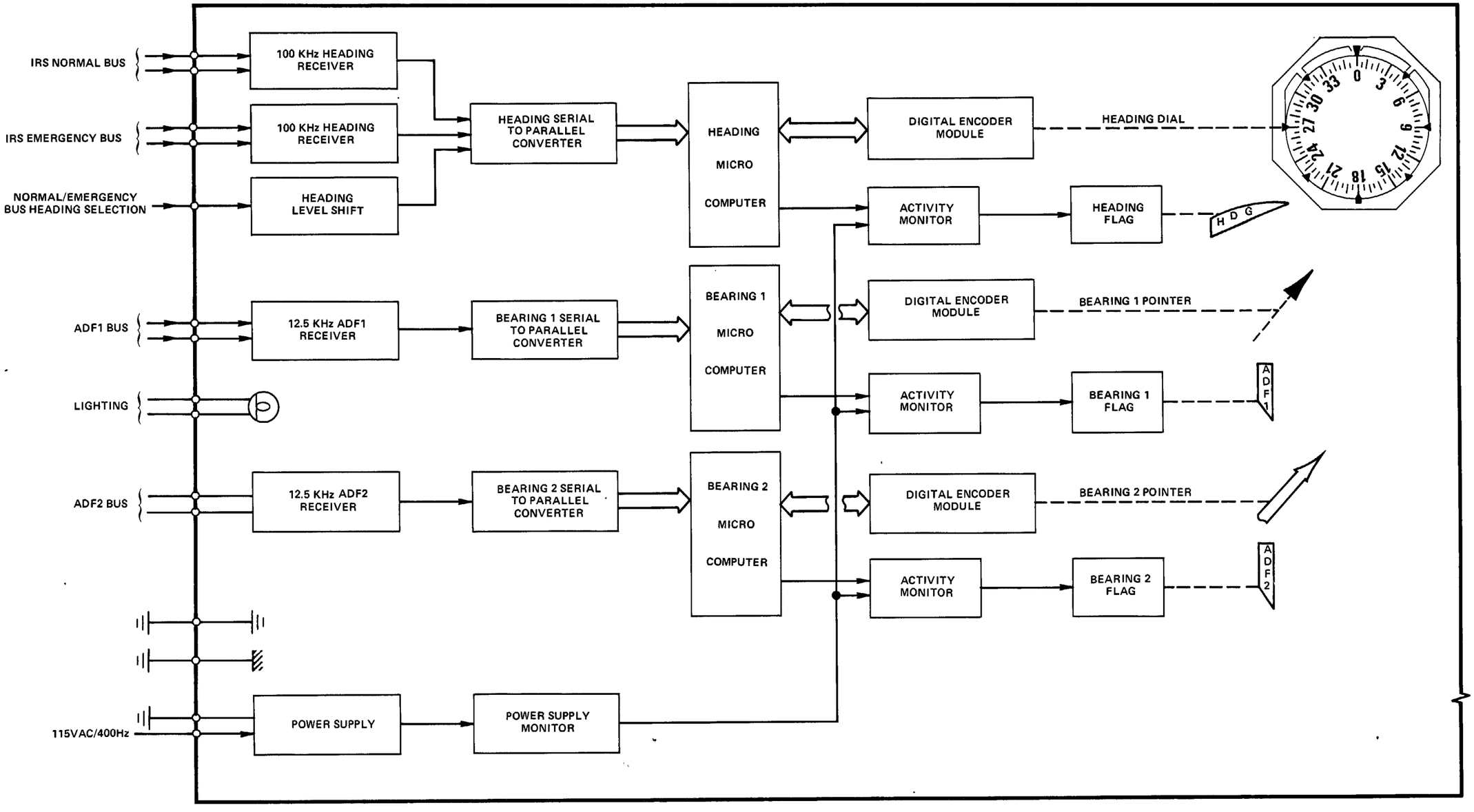
- the IRS for heading
- the ADF receiver for bearings.

The signals are adapted and shaped so as tobe transmitted to the LSI, the function of which is to ensure the reception interface with the microprocessor of the digital processing unit.

The parameter value is converted into an input angular value which



ADF RMI - Schematic
Figure 028



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RMI ADF Schematic
Figure 029

corresponds to the value of the electrical angle of a dummy resolver having the same scale factor as the output bootstrap resolver. This angular value is converted into sine and cosine digital value.

2 Bootstrap data (output)
A resolver repeats the mechanical output of the display. The output electrical signals are generated from alternating 400 Hz voltage. These signals represent, in amplitude and phase, the sine and cosine of the bootstrap angle.
These voltages are multiplexed, sampled, then converted into digital values by an analog/digital conversion channel.

3 Computation of the angular error
The input sine/cosine digital angular values are compared with the output sine/cosine digital angular values (recopy). The error signal which is thus determined triggers the motor control order. This control order is converted into a continuous signal by the digital/analog converter, then it is applied to the servomotor through a control circuit.
The servomotor drives the display system (dial and pointers) and the bootstrap resolver until the error signal is inhibited (the ouput signal is equal to the input signal).

**ON A/C 101-200,

The RMI consists of three channels : one for heading and two for ADF1 and ADF2 bearings. It is a microprocessor based unit which converts electrical information into a mechanical display of aircraft heading and ADF bearings.
Each channel consists of a receiver, a serial to parallel converter, a microcomputer and a digital encoder module.
The ARINC 429 bus provides :
- airplane magnetic heading (label 320) high speed bus
- ADF bearing data (label 162) low speed bus to the bus receivers. The receiver converts IRS heading or ADF bearing data from a ternary signal to a 32-bit serial data word. The converter converts 32-bit serial data into 4-bit parallel data (after primary or alternate heading logic, selection in the heading channel).
  Each microcomputer processes valid data and provides a servo-position signal to its digital encoder module. It monitors its own operation and valid data. Heading or bearing warning flags drop into view with any detected failure in their corresponding channel.
  Each digital encoder module provide an electro mechanical interface to position the heading dial and ADF bearing pointers. It consists of a servo-ampli, a servo-motor and an optical encoder. This last one provides position feed back to the microcomputer.
  The power supply converts 115VAC/400 Hz into +24VDC, +12VDC, -12VDC, and +5VDC. The +5VDC and ±12VDC are monitored by a power supply monitor and any detected failures will cause the heading and bearing warning flags to drop into view.

**ON A/C ALL

5. Operation

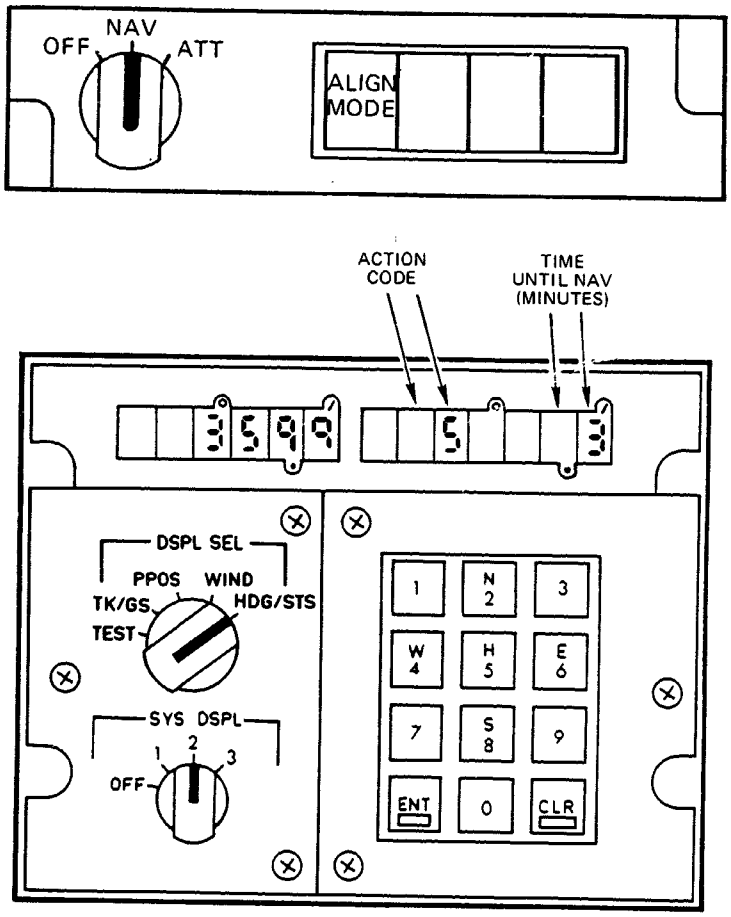
A. Main System
(Ref. Fig. 030)
(Ref. Fig. 031)
NOTE : The mode selector switch on the MSU must first be pulled and then turned to leave the NAV position. In NAV position, if you try to turn the mode selector switch before you pull it, you can damage the MSU.

(1)Normal operation : NAV MODE
The IRU is turned-on through MSU mode selector switch placed in NAV or ATT position.
The ISDU is energized by means of the SYS DSPL switch placed on an active channel (1, 2 or 3).

(a)OFF MODE : All circuitry in the IRU is de-energized except for any logic associated with the power-off function. A period of 30 seconds exists between switching to off and actual power off. However the power-off submode lasts for only 20 seconds.
NOTE : When switching the MSU selector to OFF, the IRS WARN light may come on during 20 seconds, or may not come on at all : both the results are normal.

(b)NAV MODE : after selection of the navigation mode, the IRS starts initialization and alignment submodes and then enters automatically the NAV mode 10 minutes after mode selection, if alignment has been completed ; if not, the IRS remains in the align submode
The ALIGN MODE warning light on the MSU is on during Align Submode and IRS IN ALIGN green message is displayed on ECAM system MEMO page, as long as one IRS at least is not completely aligned.
In order to complete the alignment when engaged from OFF, the IRU must receive a valid input of initial position from the FMS, or the ISDU. Position data from previous power-off cycle is stored in non-volatile memory. Initial position data must compare within one degree to the stored position ; a miscompare can be removed when two identical Set Latitudes or Set Longitudes are identical.

(c)LATITUDE COMPARISON : The IRU compares Set Latitude with a self-computed gyro-compass latitude 10 minutes into alignment or any subsequent time when a valid Set Latitude is available. The ALIGN MODE annunciator shall flash, Action Code 03 shall be transmitted and bit 21 (label 270) shall be set to a 1 when the entered latitude differs from the computed one by greater than 1 degree. The miscompare can be removed if a subsequent entry of Set Latitude passes the test.
If this test fails twice in a row with identical Latitude entries, then :
- ALIGN MODE annunciator returns to a steady on condition
- IRS WARN annunciator flashes
- Action Code 01 is transmitted
- subsequent entries are ignored
- bits : 15, 19, 21 (label 270) are set to 1.



ISDU ACTION CODE	ACTION REQUESTS	
01	REMOVE IRU	HARD FAILURE ; REMOVE IRU FOR MAINTENANCE
02	DELAYED MAINT	SOFT FAILURE ; SERVICE IRU WHEN CONVENIENT
03	ENTER PPOS	ENTER PRESENT POSITION
04	SELECT ATT	HARD FAILURE ; SELECT ATTITUDE MODE
05	EXCESS MOTION	EXCESS MOTION DETECTED DURING ALIGN
06	SWITCH ADC	AIR DATA COMPUTER INVALID
07	CHK C/B	CHECK CIRCUIT BREAKERS
08	REMOVE ISDU	REMOVE ISDU FOR MAINTENANCE
09	ENTER HEADING	ENTER HEADING FOR ATTITUDE MODE
		UNASSIGNED TBD

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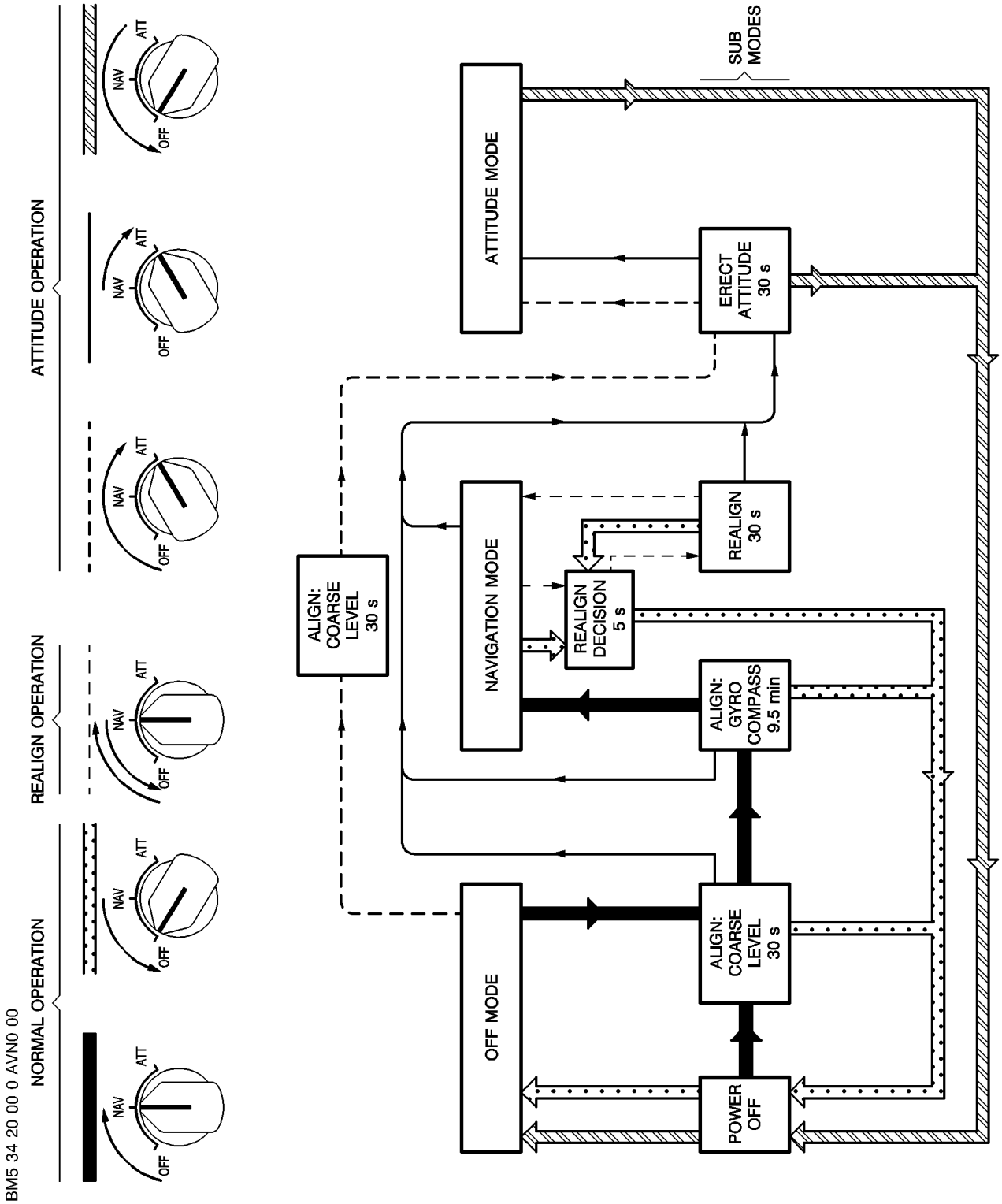
Action Code and Alignment Status
Figure 030



IRU - Mode State Diagram
Figure 031

(d)EXCESSIVE MOTION : The IRU performs an excessive motion test during the Align Submode. Bit 23 (label 270) is set to 0 at the start of alignment.
If the X or Y velocity is greater than...ft/sec, then :
- bit 23 (label 270) is set to 1
- action Code 05 is transmitted
- ALIGN MODE warning light flashes
- system reverts to a full alignment less the 2-minute initialization submode 30 seconds into the new alignment :
- bit 23 (label 270) is reset to 0
- action code 05 is no longer transmitted
- ALIGN MODE annunciator returns to a steady on condition.

(e)THREE MINUTES REALIGNMENT : A 3-minute realignment is provided by moving the MSU switch from NAV to OFF and back to NAV within five seconds. The realignment is initialized with existing attitude and heading angles and zeroed velocities. If Ground Speed from NAV exceeds 20 knots the system goes to the POWER OFF submode.
Valid position data must be received and verified by the IRU during the relignment. Bit 22 of label 270 will be set to 1, and Action Code 03 will be transmitted, until present position has been entered and has passed the position comparison test. If no data has been received at the end of the alignment the ALIGN MODE annunciator shall flash until the data has been received.
Position updates are verified by the IRU when Set Latitude compares within 0.5 degree to existing latitude and Set Longitude compares within 1.0 degree to existing longitude.
The pilot actions and IRU process to enter NAV are shown in the Nav Mode Flow Diagram (Ref. Fig. 032).

1 At point A, pilot selects NAV MODE : ALIGN MODE annunciator on MSU is on. Action Code 03 is displayed on ISDU (STATUS).
2 IRU waits for lat and long data to be entered.
3 Pilot inputs PRESENT POSITION : LATITUDE and LONGITUDE
4 At point B, if 10 minutes have elapsed with no POSITION input, ALIGN MODE annunciator on MSU flashes to request a pilot input.
5 IRU checks PPOS input to determine if the format is reasonable.
6 If PPOS was reasonable ACTION CODE 03 is no longer transmitted
7 If last inputs are not equal to the memorized data, IRU checks if they are within one degree of them. If not, ALIGN MODE warning light flashes and ACTION CODE 03 is again displayed. Pilot must re-enter PPOS.
8 At this point, system has completed alignment time. IRU performs earth rate/self-determined LATITUDE test.
9 IRU automatically enters NAV MODE.
10 IRU checks if last two latitudes entered were equal.
11 If last two LAT inputs were equal, ALIGN MODE light remains on. IRS WARN light flashes and ACTION CODE 01 (REMOVE IRU) is displayed, subsequent LAT/LONG entries will be ignored.
12 Pilot must turn off IRU and restart or replace IRU.

(f)System accuracy removal criteria.
The inertial parameters to be considered to evaluate the level of

performance of an inertial system after flight completion are :
- the Radial Position Error (Nm) (Ref. Fig. 033)
- the Drift Rate (Nm/h) (Ref. Fig. 034)
- the Residual Ground Speed Error (kts).

If the Residual Ground Speed error is 15 knots or greater after each of two consecutive flights, the IRS has to be replaced.
If the Residual Ground Speed error is 21 knots or greater at the end of any one flight, the IRS has to be replaced.
Depending on their magnitude noticed at the end of the flight, the concerned inertial system(s) shall or shall not be removed from aircraft.

(2)Emergency Operation : ATT Mode (Ref. Fig. 035, 036)

The IRS shall have a reversionary mode which can be activated only by manual selection of ATT mode on the MSU. The mode can be activated on the ground or in the air and is intended to provide a rapid attitude/heading restart capability in the event that the IRS has experienced a total power shutdown or a critical failure has occurred resulting in the following :

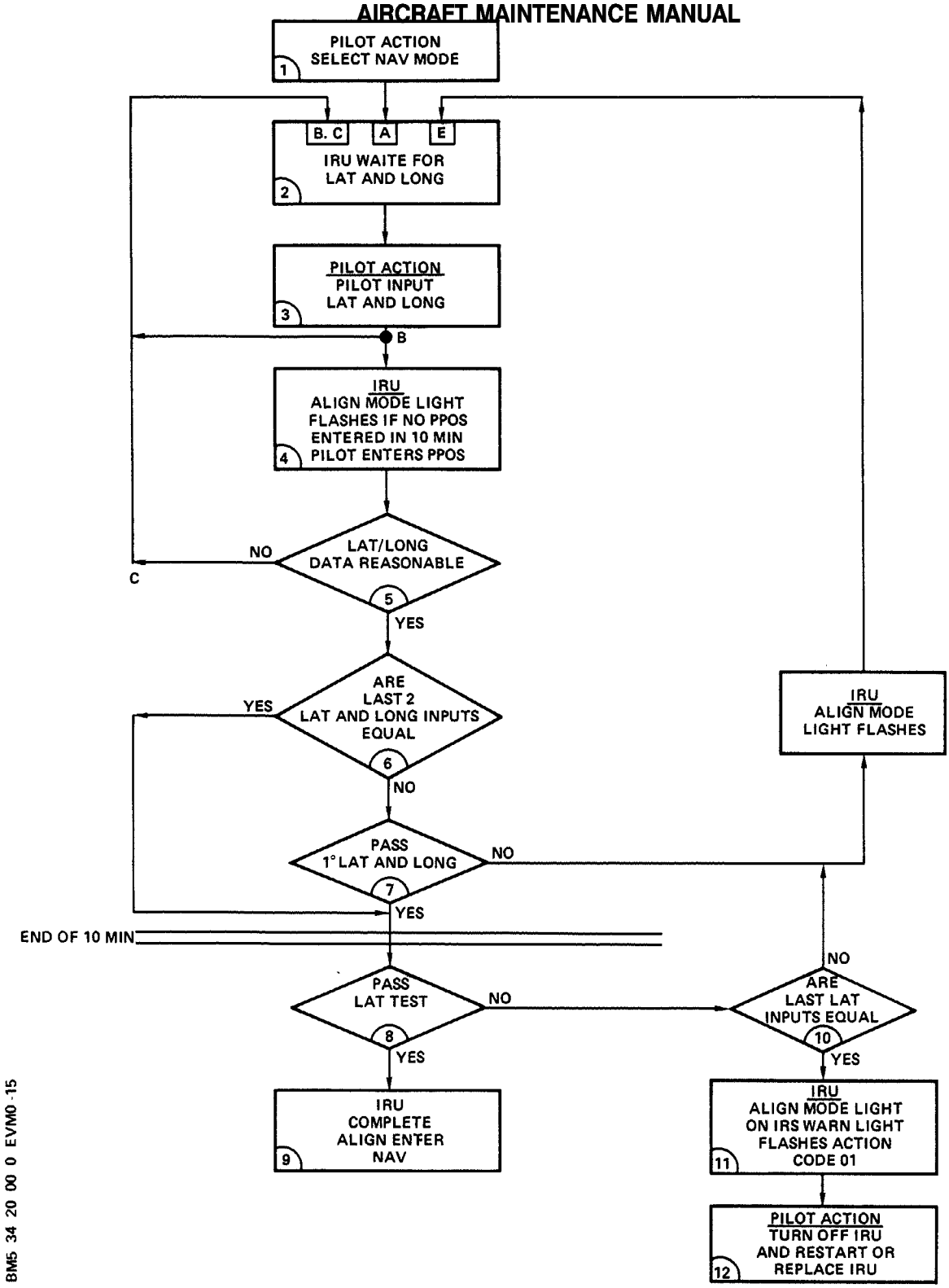
1. MSU warning light flashing
2. Action code 04 (SELECT ATT) being sent on labels 350 and 357
3. Bit 15 (ATTITUDE INVALID) and Bit 19 (IRU FAILURE) are set in word 270.

The ATT mode shall normally be engaged with the aircraft in level flight. In the event the ATT mode is engaged with the aircraft not in level flight, an erection cut-out switch shall delay erection when yaw rate exceeds 0.5 deg/sec and shall permit erection to continue when yaw rate drops below 0.25 deg/sec. Twenty seconds of flight with the erection cut-out switch disengaged is required to erect the attitude.
After the initial erection of attitude is complete, the continuous leveling of attitude shall be inhibited when the yaw rate exceeds 0.5 deg/sec and shall permit continuous leveling to continue when ever the yaw rate drops below 0.25 deg/sec.
The IRS shall be designed so that the ATT mode can be used after BITE has detected failures which will cause excessive NAV mode data errors but do not disable the ATT mode mechanization. However it is recommended to stay in NAV mode even with excessive navigation errors because of higher accuracy of attitude signals and a more complete signal processing.
ATT mode must always be used after loss of power or a simular situation in flight where a new alignment/leveling is required.
In the ATT mode the IRS shall provide valid outputs of body axis accelerations and angular rates ; pitch and roll attitude, and rate ; vertical acceleration ; vertical velocity ; inertial altitude and platform heading and magnetic heading. Magnetic heading shall be transmitted with the SSM set to NCD until a valid set heading (label 043) is received. The sign status matrices shall be in accordance with Table 3-10A, B, C. The magnetic heading output during the attitude mode shall change in the same manner as platform heading.
N/A = Not applicable.

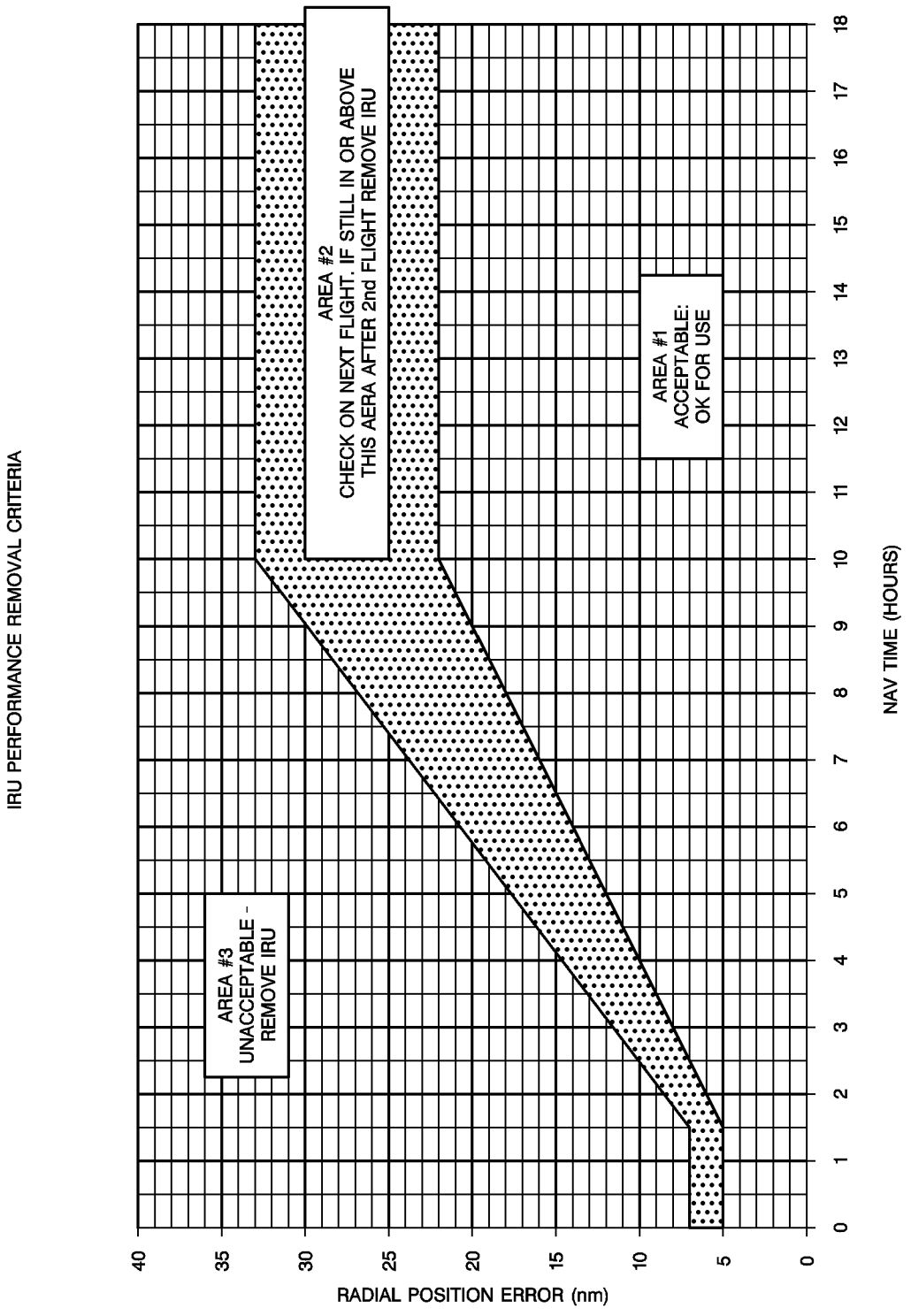
(3)Indicating and switching

(a)Attitude Information

(Ref. Fig. 037)

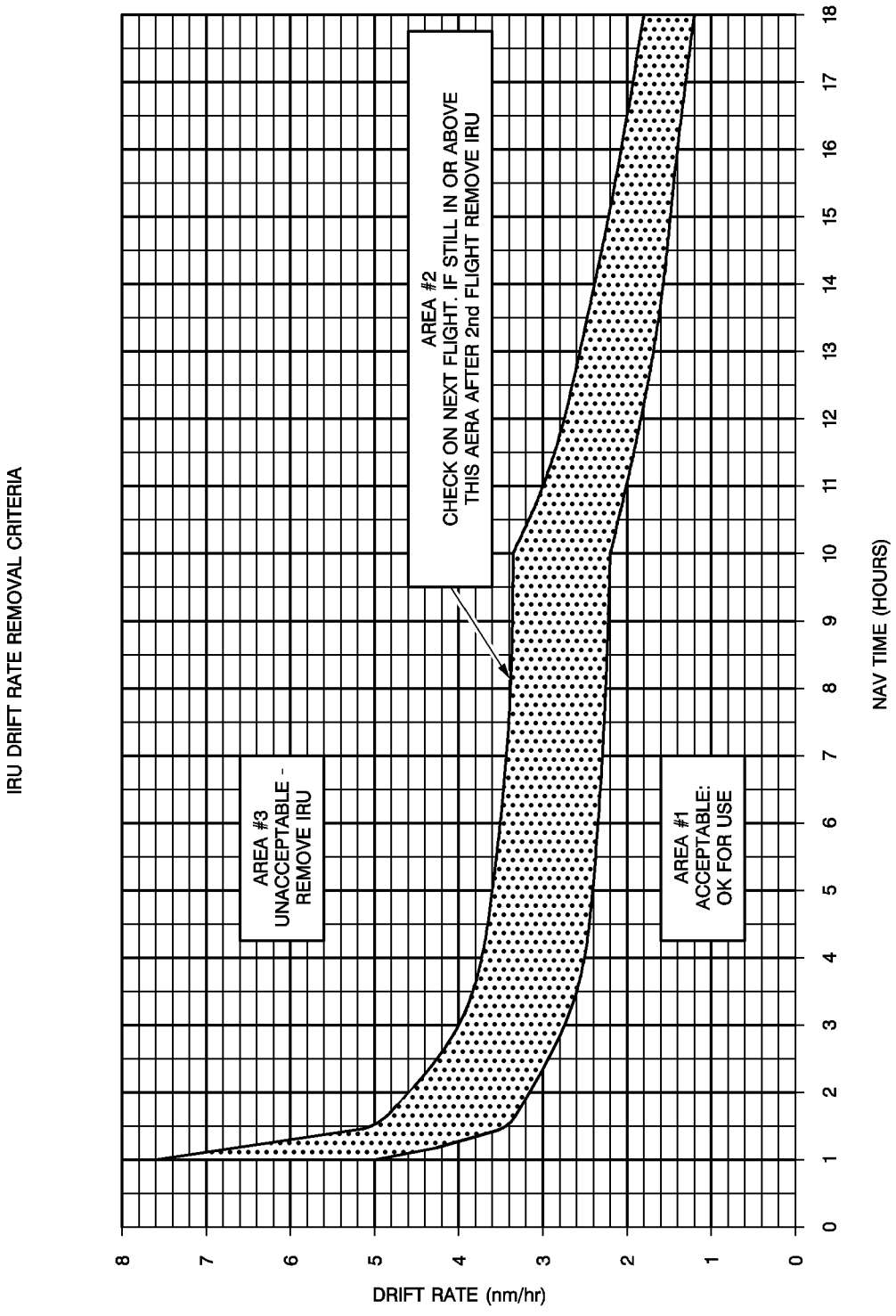


NAV Mode Flow Diagram
Figure 032



BM5 34 20 00 0 BAM0 00

IRS Accuracy Criteria - Radial Position Error (RPE)
Figure 033



BM5 34 20 00 0 BBM0 00

IRS Accuracy Criteria - Drift Rate
Figure 034

BM5 34 20 00 0 AEH0 -09

TABLE 1 – SIGN STATUS MATRIX (SSM) DEFINITION FOR BINARY OUTPUT WORDS DURING NORMAL OPERATION

ARINC LABEL	DESCRIPTION	ALIGN SUBMODE MINUTES 0 - 2	2 - 6.5	6.5 - NAV	NAV MODE GROUND SPEED LESS THAN 50 KTS	GROUND SPEED GREATER THAN 50 KTS	ERECT ATT (20 sec)	ATT MODE
310	LATITUDE	NCD	UNTIL VALID INITIALIZATION		C	C	NCD	NCD
311	LONGITUDE	NCD	UNTIL VALID INITIALIZATION		C	C	NCD	NCD
312	GROUND SPEED	NCD	NCD	NCD	C	C	NCD	NCD
313	Tk ANGLE (TRUE)	NCD	NCD	NCD	EQUALS TRUE HDG	C	NCD	NCD
314	TRUE HDG	NCD	NCD	C	C	C	NCD	NCD
315	WIND SPEED	NCD	NCD	NCD	C'	C'	NCD	NCD
316	WIND DIRECTION	NCD	NCD	NCD	C'	C'	NCD	NCD
317	Tk ANGLE (MAG)[2]	NCD	NCD	NCD	EQUALS MAG HDG	C	NCD	NCD
320	MAG HDG	NCD	NCD	C[3]	C	C	C[3]	C[3]
321	DRIFT ANGLE	NCD	NCD	NCD	EQUALS ZERO	C	NCD	NCD
322	FLIGHT PATH ANGLE	NCD	NCD	NCD	EQUALS ZERO	C	NCD	NCD
323	FLIGHT PATH ACCEL	NCD	NCD	NCD	C	C	NCD	NCD
324	PITCH ANGLE	NCD	C	C	C	C	NCD	C
325	ROLL ANGLE	NCD	C	C	C	C	NCD	C
326	BODY PITCH RATE	NCD	C	C	C	C	NCD	C
327	BODY ROLL RATE	NCD	C	C	C	C	NCD	C
330	BODY YAW RATE	NCD	C	C	C	C	NCD	C
331	BODY LONGITUDINAL ACCEL	NCD	C	C	C	C	NCD	C
332	BODY LATERAL ACCEL	NCD	C	C	C	C	NCD	C
333	BODY NORMAL ACCEL	NCD	C	C	C	C	NCD	C
334	PLATFORM HDG	NCD	NCD	C	C	C	NCD	NCD
335	TRACK ANGLE RATE	NCD	NCD	NCD	EQUALS YAW RATE	C	NCD	NCD
336	PITCH ATT RATE	NCD	C	C	C	C	NCD	C
337	ROLL ATT RATE	NCD	C	C	C	C	NCD	C
360	POTENTIAL VERTICAL SPD	NCD	NCD	NCD	NCD	C	NCD	NCD
361	INERTIAL ALT	NCD	NCD	C	C	C	NCD	C
362	ALONG TRACK HORIZ ACCEL	NCD	NCD	NCD	C	C	NCD	NCD
363	CROSS TRACK HORIZ ACCEL	NCD	NCD	NCD	C	C	NGD	NCD
364	VERT ACCEL	NCD	NCD	C	C	C	NCD	C
365	INERTIAL VERT SPD	NCD	NCD	C	C	C	NCD	C
366	N-S VELOCITY	NCD	NCD	NCD	C	C	NCD	NCD
367	E-W VELOCITY	NCD	NCD	NCD	C	C	NCD	NCD

NOTES :
1. TRANSMITTED AS NCD IF TAS IS NCD OR LESS THAN 100 KNOTS.
2. SUBSTITUTE TRUE HDG FOR MAG HDG AN Tk ANGLE (TRUE) FOR Tk (MAG) FOR LATITUDES GREATER THAN 70° N AND 60° S.
3. COMPUTED ONLY AFTER VALID POSITION INITIALIZATION.
4. THE RAPID REALIGN SSM WILL BE THE SAME AS COLUMN 6.5 – NAV (ALIGN SUBMODE).
5. TRANSMITTED AS NCD UNTIL VALID HEADING INITIALIZATION.

C = COMPUTED DATA (NORMAL OPERATION).
NCD = NO COMPUTED DATA
F = FAIL WARNING

Table 1 - Sheet 1/2
Figure 035

BM5 34 20 00 0 AEJD 09

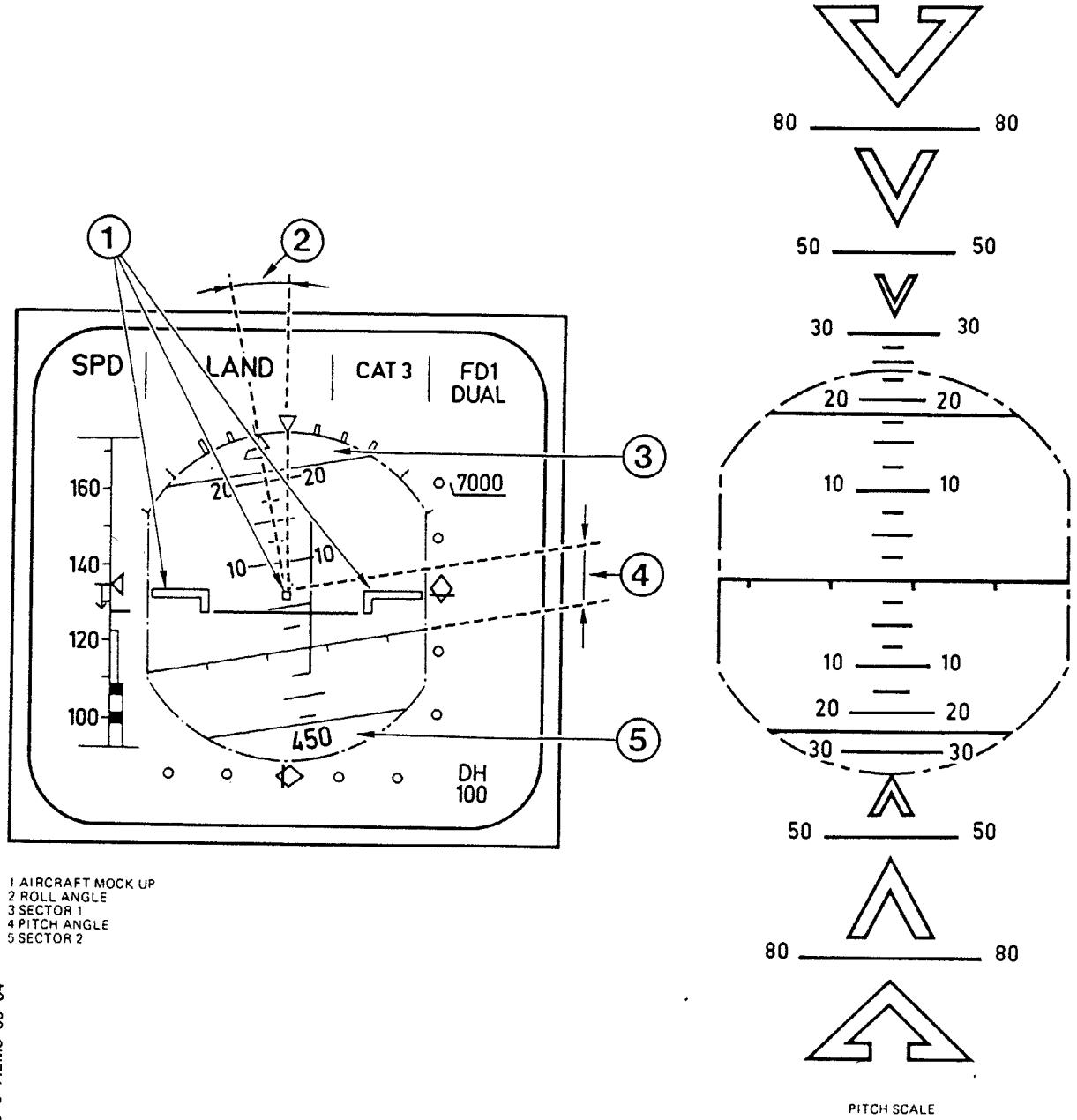
SIGN STATUS MATRIX (SSM) DEFINITION FOR BCD CODED ANS SPECIAL OUTPUT WORDS DURING NORMAL OPERATION

ARINC LABEL	DESCRIPTION	ALIGN SUBMODE MINUTES 0	2	2	6.5	6.5	NAV MODE NAV	GROUND SPEED LESS THAN 50 KTS	GROUND SPEED GREATER THAN 50 KTS	ERECT ATT (20 sec)	ATT MODE
	BCD CODED WORDS										
010	LATITUDE	NCD	UNTIL VALID INITIALIZATION					C	C	NT	NT
011	LONGITUDE	NCD	UNTIL VALID INITIALIZATION					C	C	NT	NT
012	GRND SPD	NCD		NCD			NCD	C	C	NT	NT
013	TK ANGLE TRUE	NCD		NCD			NCD	EQUALS TRUE HDG	C	NT	NT
014	MAG HDG[1]	NCD		NCD			C[1]	C	C	C[1]	C[1]
015	WIND SPEED	NCD		NCD			NCD	C[1]	C[1]	NT	NT
016	WIND DIR	NCD		NCD			NCD	C[1]	C[1]	NT	NT
041	SET LATITUDE	———		NOTE 4			———	NOT TRANSMITTED	NOT TRANSMITTED	NT	NT
042	SET LONGITUDE	———		NOTE 4			———	NOT TRANSMITTED	NOT TRANSMITTED	NT	NT
043	SET MAGNETIC HEADING	———	NOT TRANSMITTED				———	NOT TRANSMITTED	NOT TRANSMITTED	NOTE 4	NOTE 4
044	TRUE HDG	NCD		NCD		C		C	C	NT	NT
	SPECIAL (DISCRETE) WORDS										
270	(IRS DISCRETE)	C		C		C		C	C	C	
277	(IRS TEST)	C		C		C		C	C	C	
350	ACTION CODE	C		C		C		C	C	C	
351	IRSMT (MAINTENANCE)	C		C		C		C	C	C	
357	ACTION REQUEST	———					SSM CONVENTION NOT USED			———	
377	EQUIPMENT ID	C		C		C		C	C	C	

NOTES:
1. TRANSMITTED AS NCD IF TAS IS NCD OR LESS THAN 100 KNOTS.
2. SUBSTITUDE TRUE HDG FOR MAG HDG FOR LATITUDES GREATER THAN 70°N AND 60°S.
3. COMPUTED ONLY AFTER VALID INITIALIZATION.
4. BURST MODE – NOT TRANSMITTED UNTIL VALID INITIALIZATION.
5. TRANSMITTED AS NCD UNTIL VALID HEADING INITIALIZATION.

C = COMPUTED DATA (NORMAL OPERATION)
NCD = NO COMPUTED DATA
F = FAIL WARNING
NT = NOT TRANSMITTED

Table 1 - Sheet 2/2
Figure 036



1 AIRCRAFT MOCK UP
2 ROLL ANGLE
3 SECTOR 1
4 PITCH ANGLE
5 SECTOR 2

BM5 34 20 00 0 AEM0 09 04
DM5

PFD Attitude Display
Figure 037

(Ref. Fig. 038)

The attitude indications are provided to the crew by the main EFIS DU flight instruments : Primary Flight Displays for the main information computed by the IRS.

1 Sphere

The aircraft roll and pitch attitude is indicated in the image center part by a sphere representing a conventional ADI drum.

The horizon line position with respect to the aircraft symbol (1) gives the roll and pitch angles.

The "sky" zone which indicates nose-up pitch angles with respect to the symbol is blue.

The "earth" zone which indicates nose-down pitch angles with respect to the symbol is brown.

The upper part of the sphere (in zero roll angle configuration) includes a sector (3) which remains blue whatever the pitch angle.

The lower part of the sphere (zero roll angle) (5), remains brown whatever the pitch angle value ($-90<\theta<90$). These 2 sectors rotate in roll and are thus inverted when the roll (or the pitch) angle is > 90.

2 Pitch data

The pitch scale is white

The zone used most has a 2.5° graduation scale ($-20^\circ<\theta<30^\circ$).

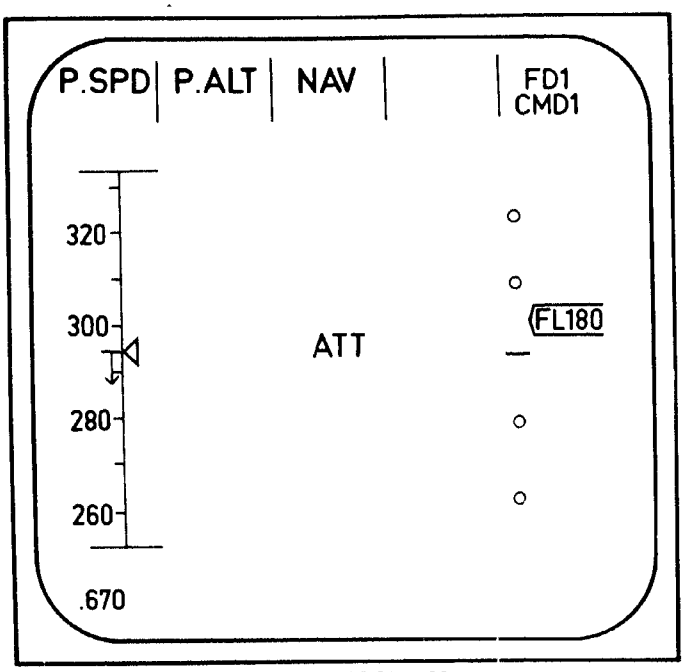
The sensitivity varies with the operation range

. $-5^\circ\leq\theta\leq20^\circ$ 1.8mm/degree

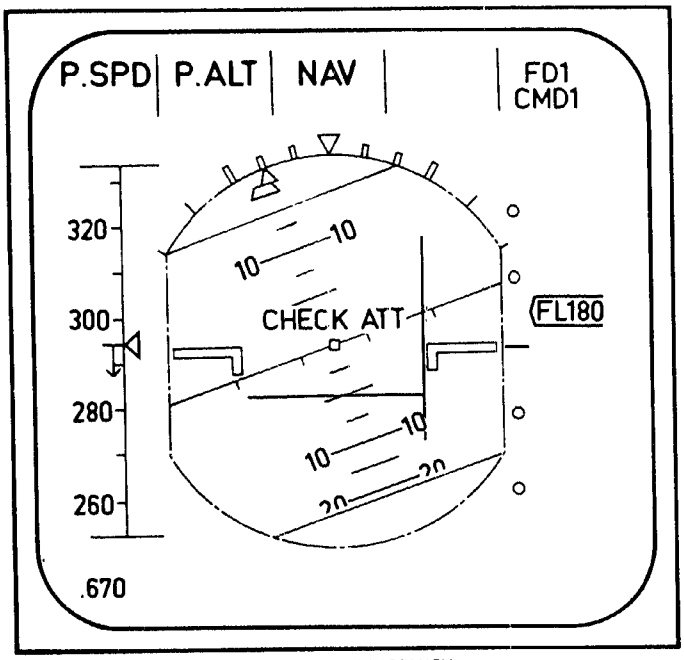
. $\theta\geq30^\circ$ or $\theta\leq-20^\circ$ 1mm/degree

. $20^\circ<\theta<30^\circ$ or $-15^\circ<\theta<-5^\circ$ linearly variable sensitivity

The excessive pitch zones are marked by red V. When pitch angle becomes >25° (or <-13°) all PFD data other than attitude, speed and heading is cancelled.



ATTITUDE FAILURE



ATTITUDE DISCREPANCY

BM5 34 20 00 0 AES0 09 04
DM5

ATT Flag Display on PFD
Figure 038

The display becomes normal when angle is <22° (or >-10°).
In case of pitch failure all the sphere is cancelled and in lieu of it a red ATT flag comes into view which, at first, flashes for a few seconds.
This flag can come into view :
- in the event of failure of the IRS in use
- or when EFIS system internal monitoring has detected an attitude failure.

When a difference between the sides 1 and 2, greater than 4° is detected by the FWC, a message CHECK ATT is displayed in red on both PFDs; however the attitudes are still displayed. The crew must perform a crosscheck by using standby instruments for example.

3 Roll data

The white roll scale is drawn above the sphere. It is graduated from -60° to +60°, with fixed markings at ±60°; ±45°; ±30°; ±20°; ±10°; 0°.
The yellow pointer moves as per roll angle along the sphere contour.
Sectors 1 and 2 turn at the same time.
When roll angle is >45° all PFD displays other than attitude, speed and heading data are cancelled. The display becomes normal when angle is <40°.
In case of roll failure all the sphere is cancelled and in lieu of it a red ATT flag comes into view, which, at first, flashes for a few seconds.
This flag can come into view
- in the event of failure of the IRS in use
- or when EFIS system internal monitoring has detected an attitude failure.

When a difference between the sides 1 and 2 greater than 4° is detected by the FWC, a message CHECK ATT appears on both PFDs; however, attitudes are still displayed. The crew must perform a cross-check by using standby instruments for example.

(b)Heading information

The magnetic heading main data is provided to the crew by the main EFIS DU instruments : Navigation displays and primary flight displays. These instruments display magnetic heading calculated by the IRS.

1 On the PFD

A blank heading scale (with graduations without any indicated value) is provided on the horizon line : 1 graduation every 10 degrees (sensitivity 1.6 mm/degree)
(Ref. Fig. 039) (part A)
This scale moves as the aircraft heading varies. For important nose-up attitudes, the horizon line disappears under the lower sector limit, the heading graduations remain then at this limit
(Ref. Fig. 039) (part B)
In the same way for important nose-down attitudes, graduations will remain at the upper sector limit
(Ref. Fig. 039) (part C)
In case of heading failure, heading graduations disappear.
(Ref. Fig. 039) (part D)

2 On the ND

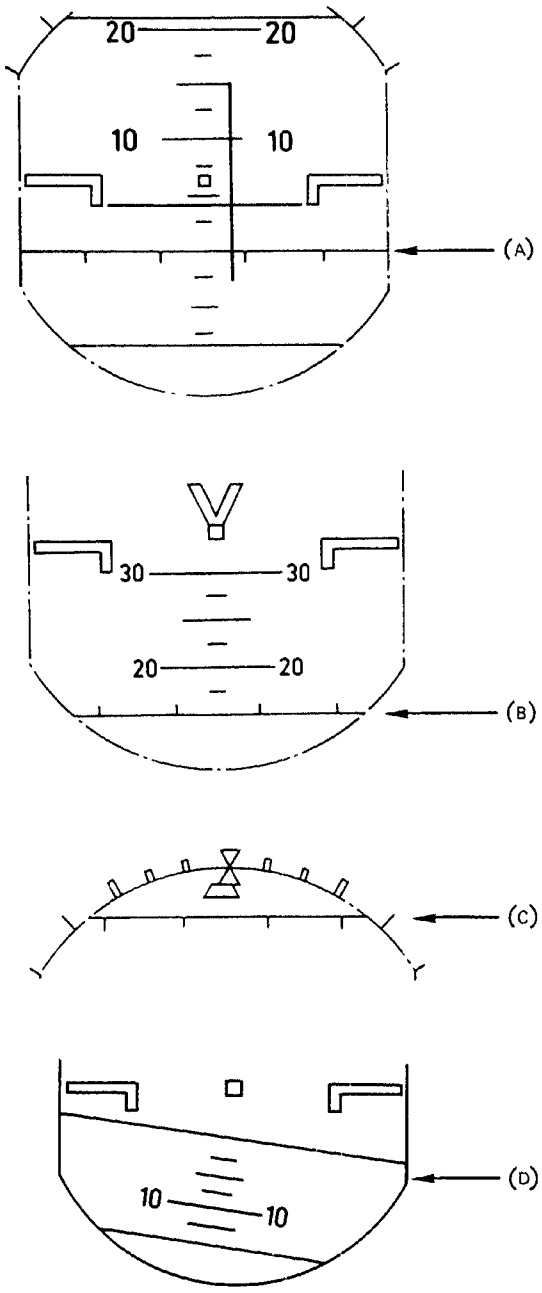
The heading data can be displayed on the ND in the three following

operating modes : ROSE, ARC and MAP. (PLAN mode displays a static map)
- ROSE mode (Ref. Fig. 040)
  The heading is displayed by a rotating scale graduated every 5 degrees and orientated to aircraft magnetic heading marked by a yellow triangle.
  In case of heading failure, the scale and all the symbols positioned on this scale are cancelled ; then a red HDG flag comes into view above the rose after flashing for a few seconds.
This flag comes into view :
- in the event of failure of the IRU in use
- or when EFIS system internal monitoring has detected a failure in the magnetic heading message. When a difference between sides 1 and 2 is detected by the FWC, a message CHECK HDG is displayed in amber on both NDs.

(Ref. Fig. 041)
The corresponding heading remains displayed and the crew must perform a crosscheck by using the standby compass for instance.
MAP mode and ARC mode (Ref. Fig. 042, 043)
A heading scale (item 5) is displayed in white at the display upper part. It moves as the aircraft heading varies.
The aircraft magnetic heading is marked by a yellow triangle (item 1) at the scale center part.
In case of heading failure, a red HDG flag comes into view under the scale after flashing for a few seconds
In case of magnetic heading difference (greater than 4°) between sides 1 and 2 a message CHECK HDG is displayed in amber on both NDs.
The crew must perform a crosscheck between both NDs by using standby compass for instance.
(Ref. Fig. 039)
(Ref. Fig. 040)
(Ref. Fig. 041)
(Ref. Fig. 042)
(Ref. Fig. 043)

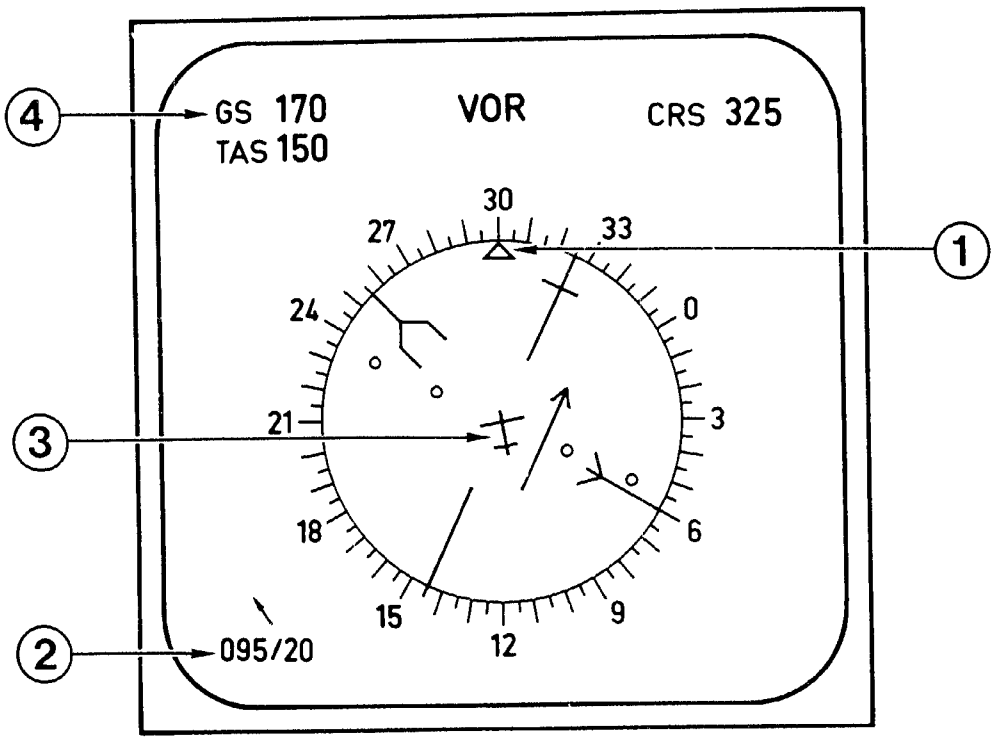
3 On VOR/DME RMI
Magnetic heading is indicated by a circular dial (heading dial) which moves with respect to a fixed index (lubber line) and which recopies the heading digital message (ARINC 429 type high speed) received from the IRS1 for Captain's indicator and from the IRS2 for First Officer's indicator in normal operation.
When a failure is detected, a fire orange warning flag with HDG written in black comes into view at the heading dial upper part, two seconds after failure detection and VOR Flag comes into view.

4 On ADF RMI
Magnetic heading is indicated by a circular dial (heading rose) which moves with respect to a fixed index (lubber line) and which recopies the heading digital message (ARINC 429 type high speed) received from the IRS2 for Captains's indicator and from the IRS1 for First Officer's indicator in normal operation.
When a failure is detected, a fire orange warning flag marked HDG in black comes into view at the heading dial upper part, two seconds after failure detection.



BM5 34 20 00 0 AEX0 09 04
DM5

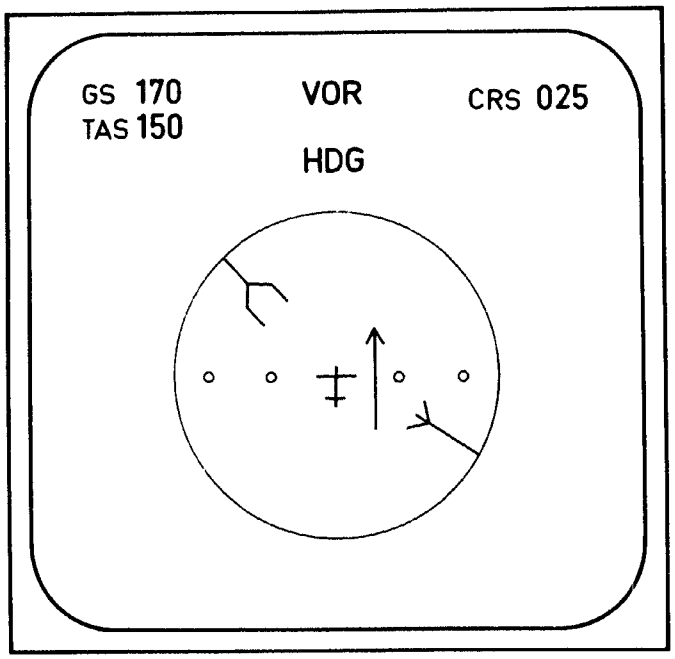
PFD Heading Scale Display
Figure 039



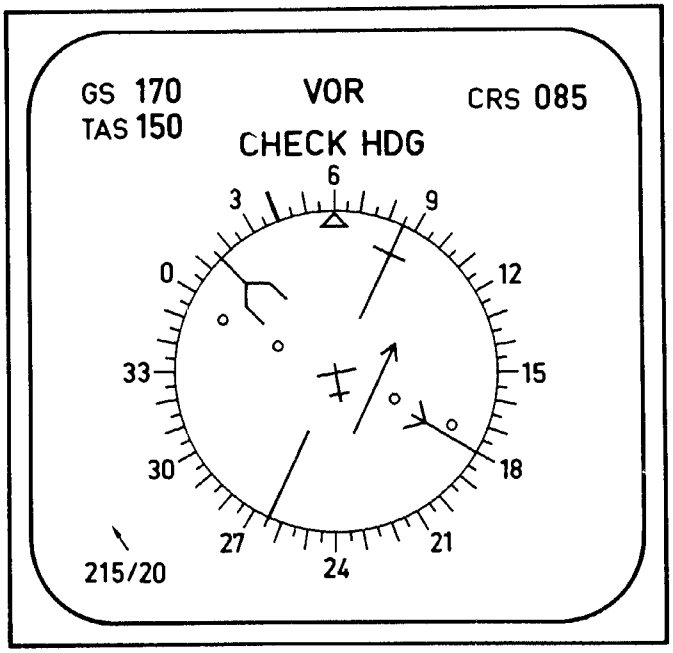
1 - MAGNETIC HEADING (320)
2 - WIND DATA (315, 316)
3 - MAGNETIC TRACK (317)
4 - GROUND SPEED (012)

BM5 34 20 00 0 AFCO 09 04
DM5

ND - Rose Mode
Figure 040



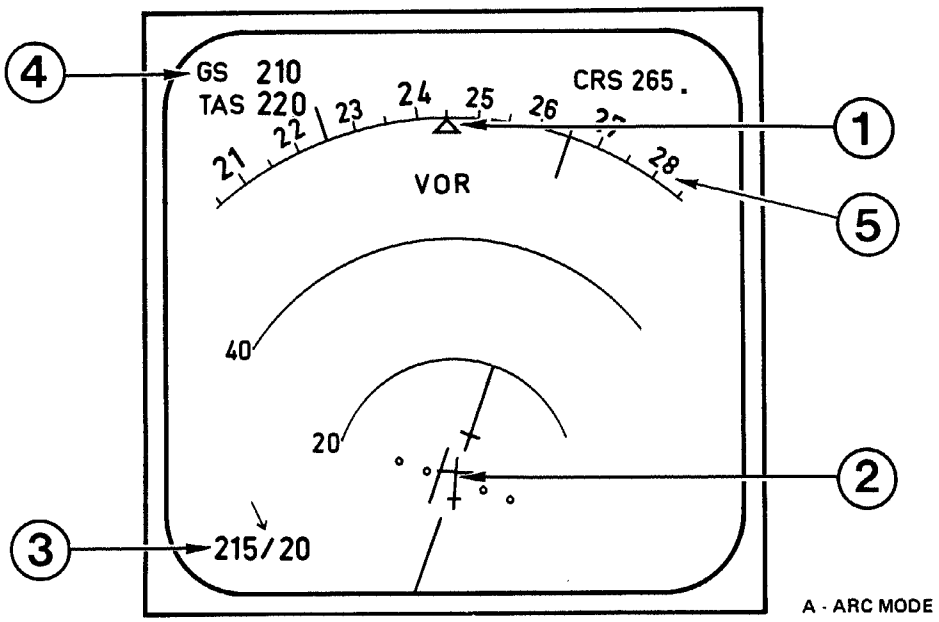
HEADING FAILURE



HEADING DISCREPANCY

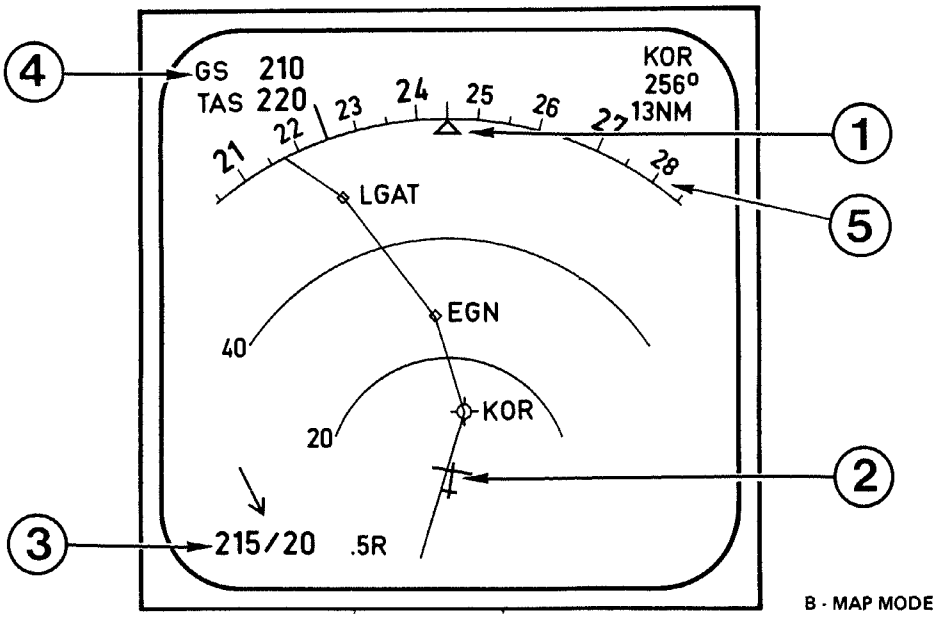
8M5 34 20 00 0 AFH0 09 04
DM5

ND - Rose Mode - Heading Warning Messages
Figure 041



A - ARC MODE

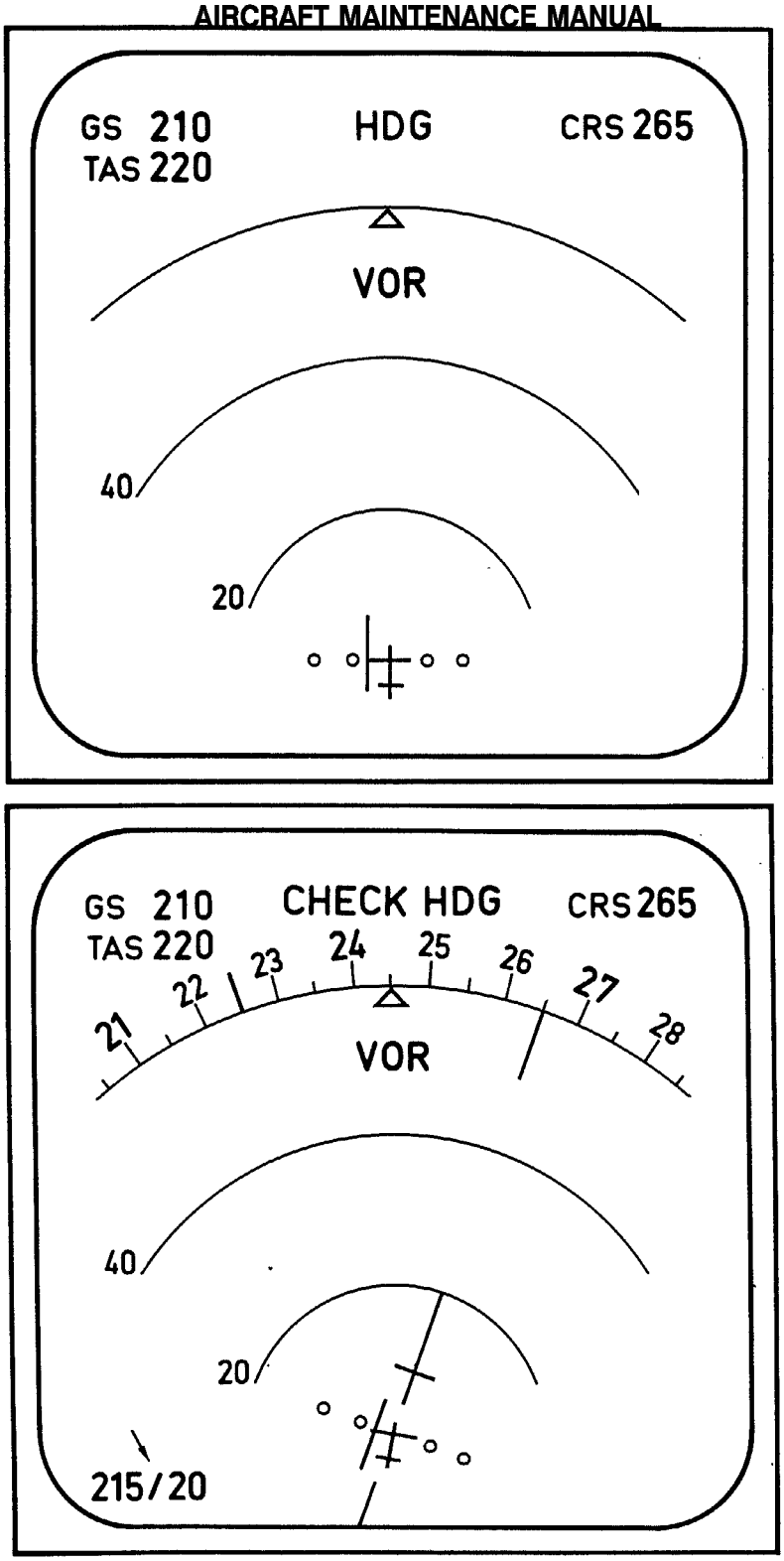
1 - MAGNETIC HEADING (320)
2 - MAGNETIC TRACK (317)
3 - WIND (315,316)
4 - GROUND SPEED (012)
5 - HEADING SCALE



B - MAP MODE

BM5 34 20 00 0 AFNO-15-10
DM5

ND - Arc Mode and Map Mode
Figure 042



BM5 34 20 00 0 AFTO 15-10
DM5

ND - Arc Mode - Heading Warning Messages
Figure 043

(c)Other information displayed

1 On PFD

- Flight Path Vector

(Ref. Fig. 044) (Part B)

The flight path vector is displayed in FPV mode.

The flight path vector provides display of the aircraft trajectory in path and slope

- the lateral deviation with respect to the aircraft symbol represents the drift.
- the vertical deviation with respect to the horizon line represents the slope followed
  - . if the flight path vector is on the horizon line, the aircraft is in level flight
  - . if it is below the horizon line, the aircraft is in descent configuration
  - . if it is above the horizon line, the aircraft is in climbing configuration

The pitch graduations serve as slope graduations

The flight path vector is displayed in FPV mode whatever the AFS mode selected.

In case of failure, it is cleared and a red FPV failure warning message which first flashes for a few seconds, is displayed below the aircraft symbol

NOTE : The flight path vector is not displayed below 50 kts on ground, in NAV mode.

NOTE : Furthermore the EFIS displays the flight path target.

The flight path target provides display of the trajectory selected in path and slope. It is only displayed when FPA key on EFIS control panel is pressed.

- Cross Track Acceleration

(Ref. Fig. 044) (Part A)

Side slip is indicated by a yellow trapezoidal index which moves below the roll index

The displacement of these two indexes with respect to each other is proportional to the lateral acceleration : 1cm = 0.2g.

The side slip index is against stop beyond 0.30g, and so remains immobilized in the position which corresponds to this value.

It is cleared in case of failure.

2 On ND

- Ground Speed

(Ref. Fig. 040, 042)

The ground speed is displayed in green in the upper left hand corner of the ND.

If this data is not available, the digital values are replaced by dashed lines : GS---.

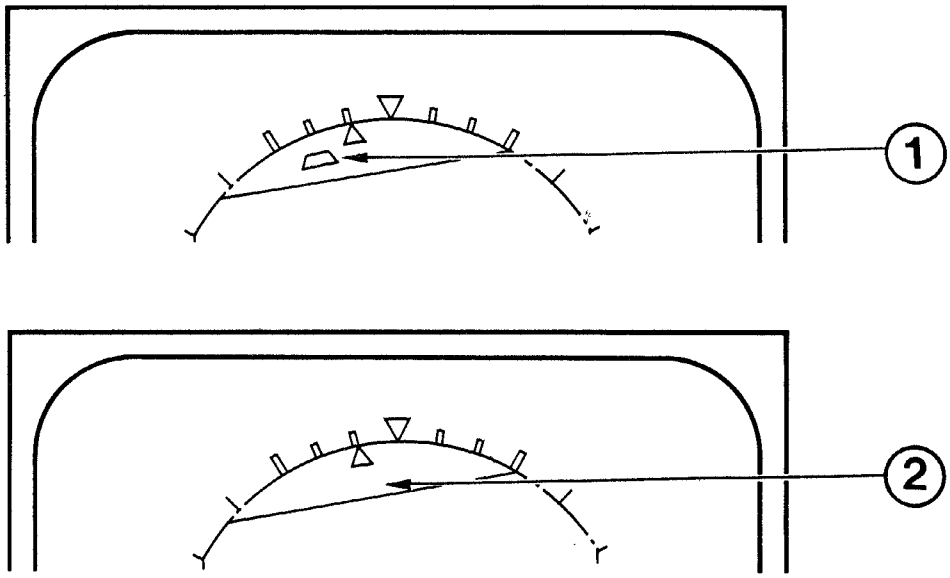
In the case of failure, the data is cleared.

- Wind data

(Ref. Fig. 040, 042)

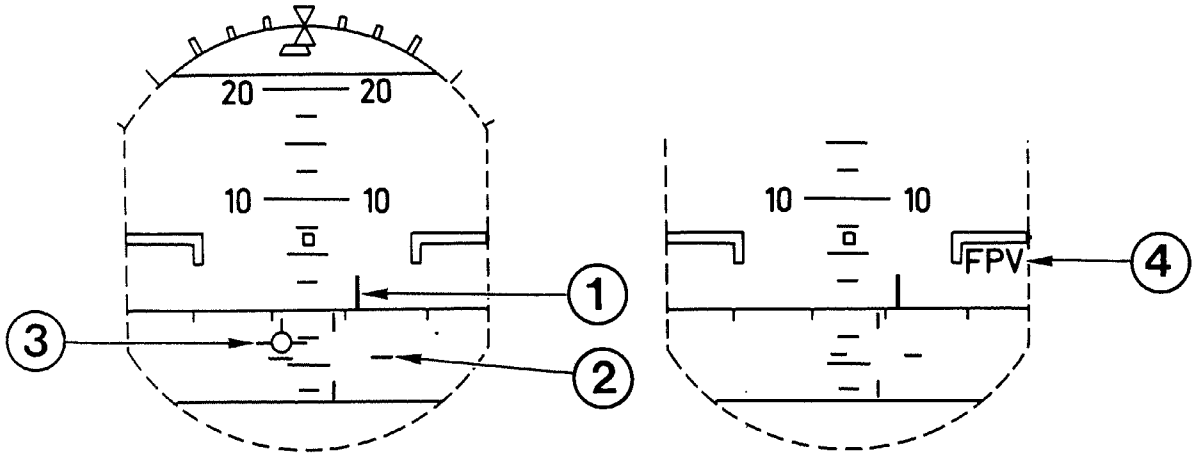
The wind direction and speed are displayed in green in the lower left hand corner of the ND.

The pointer indicates the magnetic wind direction.



1 - SIDE - SLIP INDEX
2 - LOSS OF SIDE-SLIP INDICATION

A) PFD - SLIP INDICATOR



B) PFD - FLIGHT PATH VECTOR PRESENTATION

1 SELECTED HEADING
2 FLIGHT PATH TARGET
3 FLIGHT PATH VECTOR
4 FPV FAILURE WARNING MESSAGE

BM5 34 20 00 0 AFY0 09 04
DM5

PFD - Slip Indication and Flight Path Vector Presentation
Figure 044

The digits indicate the direction where the wind comes from and its speed.
In case of failure, the data is cleared.

- Magnetic Track
The track is not represented by a symbol. It is indicated by the direction of the aircraft symbol in relation to the lubber line.
In the event of track data failure the aircraft symbol is replaced by a yellow circle.

3 On ISDU
The ISDU provides display of the following data : Present Position, True Track, Ground Speed, True Heading, Status, Magnetic Heading (in ATT mode).

**ON A/C 001-003,

4 On VSI

**ON A/C 004-200,

4 On VSI/TCAS indicators

**ON A/C 001-003,

(Ref. Fig. 045)

**ON A/C 004-200,

(Ref. Fig. 046)

**ON A/C 001-003,

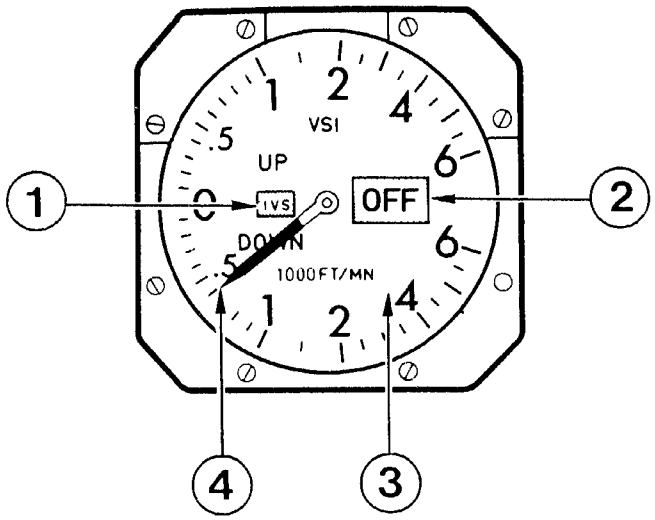
The VSI displays inertial vertical speed of associated IRS
In case of IRS failure, a yellow warning flag marked IVS comes into view on the indicator face and the indicator is automatically switched to ADC data bus.
NOTE : In all cases, if both ADCs fail a red OFF flag comes into view.

(d)Switching

**ON A/C 004-200,

The CAPT and F/O VSI/TCAS indicators display inertial vertical speed of IRU1 and IRU2 respectively. In case of IRU failure, a yellow warning flag marked IVS comes into view on the concerned indicator face.
CAPT (F/O) indicator can be automatically switched to ADC1 (2) data bus.
NOTE : In all cases, if both ADCS fail, a yellow V/S flag comes into view.

(d)Switching



1 IVS FLAG (ARC YELLOW)
THIS FLAG COMES INTO VIEW WHEN THE INERTIAL VERTICAL SPEED FROM THE ALTITUDE SYSTEM, POWER SUPPLY OR INDICATOR IS FAULTY

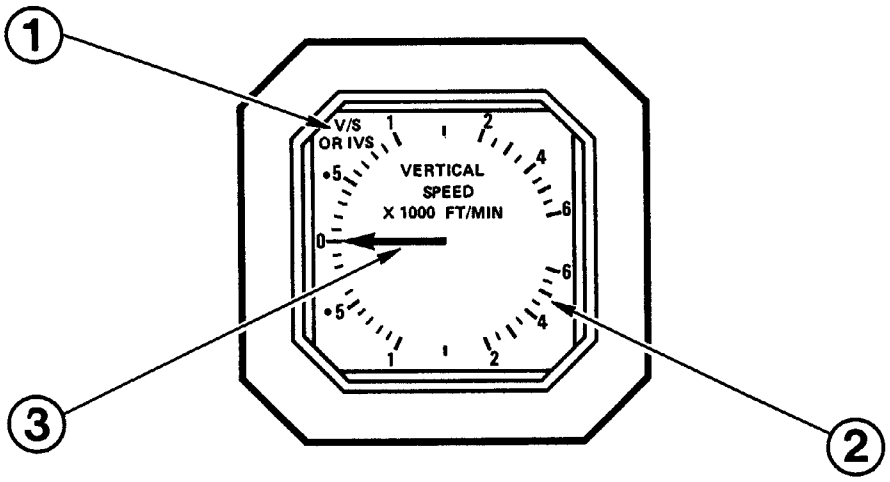
2 OFF FLAG (RED)
THIS FLAG IS IN VIEW WHEN THE ALTITUDE RATES FROM BOTH ADCS ARE INVALID OR ABSENT. IT ALSO IS IN VIEW IN THE EVENT OF A POWER OR INDICATOR FAILURE.

3 VERTICAL SPEED DIAL
THE DIAL IS GRADUATED TO 6000 FT/MIN UP AND DOWN, WITH SPREAD OUT GRADUATIONS BETWEEN 0 AND ± 1000 FT/MIN.

4 VERTICAL SPEED POINTER (WHITE)
THE POINTER MOVES ON THE DIAL. IN THE ABSENCE OF VERTICAL SPEED VALID SIGNALS, THE POINTER IS POSITIONED AT ZERO

BM5 34 20 00 0 AGD0 09 04
DM5

Vertical Speed Indicator
Figure 045



-1- IVS FLAG (YELLOW)
THIS FLAG COMES INTO VIEW WHEN THE INERTIAL VERTICAL SPEED FROM THE ALTITUDE SYSTEM, POWER SUPPLY OR INDICATOR IS FAULTY.

V/S FLAG (YELLOW)
THIS FLAG IS IN VIEW WHEN THE ALTITUDE RATES FROM BOTH ADCS ARE INVALID OR ABSENT.

-2- VERTICAL SPEED DIAL
THE DIAL IS GRADUATED TO 6000 FT/MIN UP AND DOWN, WITH SPREAD OUT GRADUATIONS BETWEEN 0 AND ± 1000 FT/MIN.

-3- VERTICAL SPEED POINTER
THE POINTER MOVES ON THE DIAL IN THE ABSENCE OF VERTICAL SPEED VALID SIGNALS, THE POINTER IS NOT VISIBLE.

BM5 34 20 00 0 AGN0 00

VSI/TCAS Indicator
Figure 046

**ON A/C 001-100,

(Ref. Fig. 047)

**ON A/C 101-200,

(Ref. Fig. 048)

**ON A/C ALL

1 PFD and ND
Bus No.1 from IRS 1 normally supplies EFIS SGU 1 which controls the Captain's PFD and ND.
Bus No.1 from IRS 2 normally supplies EFIS SGU 2 which controls the First Officer's PFD and ND.
In case of IRS failure, the EFIS SGU normally associated with the failed IRS can use IRS 3 bus. The IRS 3 can be used only by one of the two SGUs, 1 or 2, at the same time. The Captain has priority for this selection. In case of a failure of EFIS SGU 1 or 2, either can be replaced by SGU 3 after selection by the crew.
The Captain has priority in this selection.
The selection of these reconfigurations is at the crew's disposal on panels 402VU and 406VU.
This selection is made through ATT HDG and EFIS SGU illuminated pushbutton switches.
NOTE : The ATT HDG selection simultaneously concerns attitude and magnetic heading information.

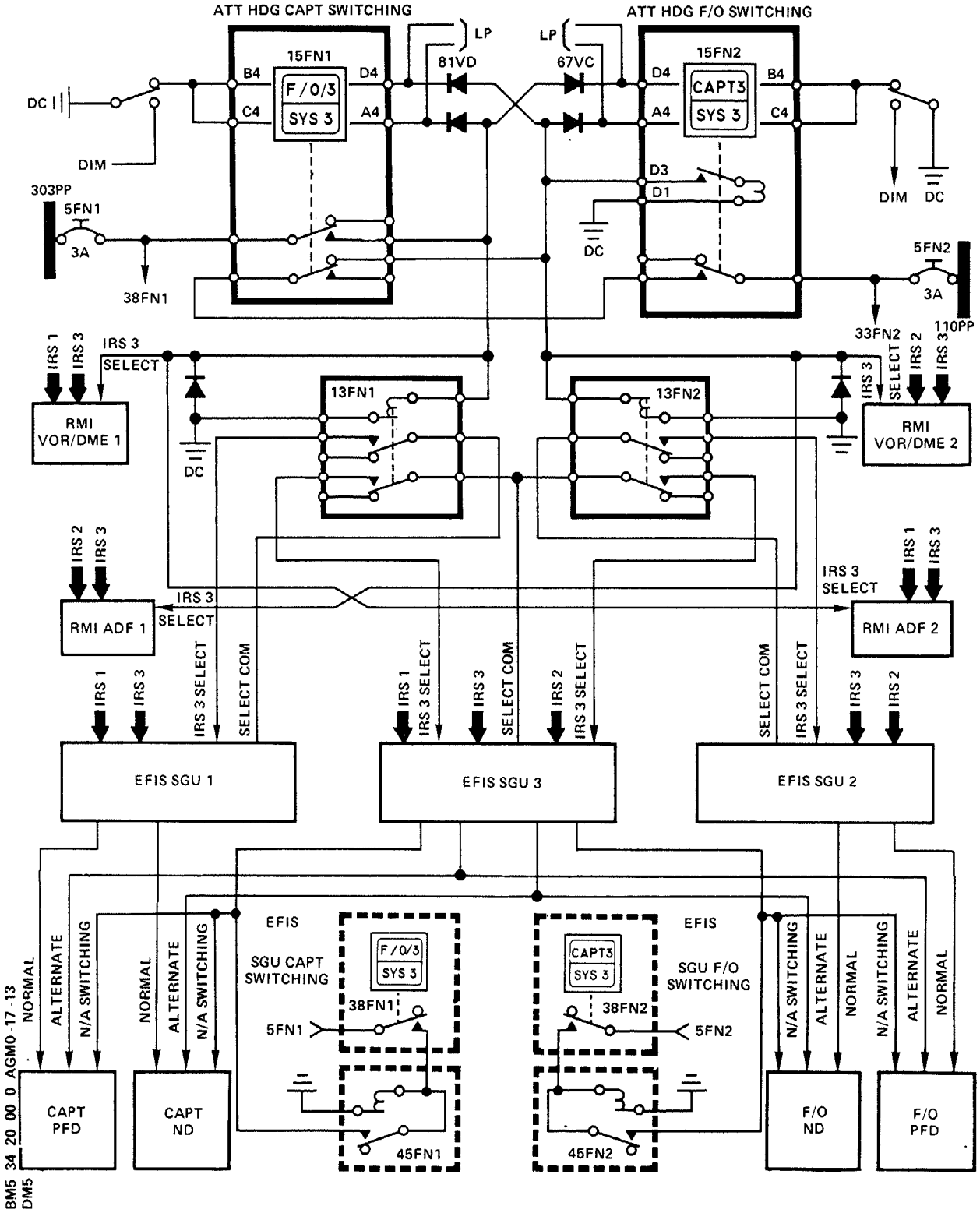
2 VOR/DME and ADF RMI
Operation in emergency mode is selected by using ATT HDG pushbutton switches located on LH and RH instrument panels 402VU and 406VU. This system enables switching of heading data from Captain's or First Officer's RMI to IRS3. This bus switching is integral with the instrument and performed by a totally static system.

(4)Test and monitoring

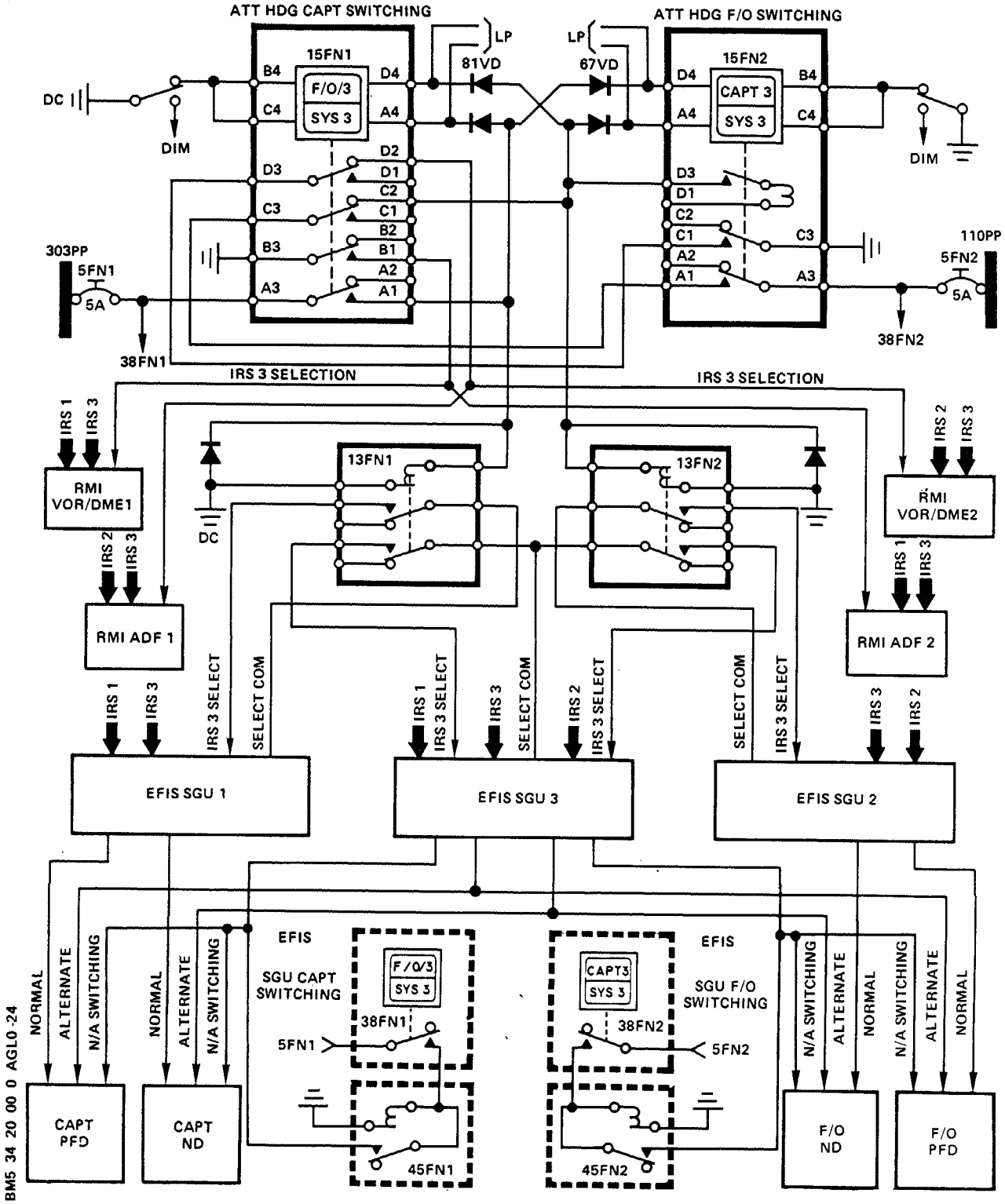
(a)Test
The system allows, by manual selection, MSU warning lights and ISDU displays to be tested ; it performs some tests itself, by hardware and software, to check correct operation of the system.

- Checking of MSU warning lights and ISDU displays
The MSU warning lights and the ISDU displays can be checked when ANN LT switch is placed in TEST position on panel 436VU, the four MSU warning lights, all the ISDU display segments and points, and CLR and ENT keys must also come on.
The ISDU can also be tested by placing the ISDU switch in TEST position.

- Bite Test
The functional test is performed by pressing the IRS1 (IRS2, IRS3, respectively) pushbutton switch located on maintenance panel 470VU.
The test is performed as long as the pushbutton switch is pressed and the digital outputs are forced to the following values :



Switching Block Diagram
Figure 047



Switching Block Diagram
Figure 048

LABEL	PARAMETER	VALUE	INSTRUMENT
010	PRES POS - LAT.	N 22.50°	ISDU
011	PRES POS - LONG.	E 22.50°	ISDU
012	GROUND SPEED	200 KTS	ISDU/ND
013	TRACK ANGLE TRUE	0.00°	ISDU/ND
014	MAG HEADING	15.0°	
015	WIND SPEED	100 KTS	
016	WIND DIRECT TRUE	30.0°	
044	TRUE HEADING	10.0°	ISDU
270	IRS DISCRETE	N/A	
277	IRS TEST	*	
310	PRES POS - LAT.	N 22.50°	
311	PRES POS - LONG.	E 22.50°	
312	GROUND SPEED	200 KTS	ND
313	TRACK ANGLE TRUE	0.00	ND
314	TRUE HEADING	10.0°	
315	WIND SPEED	100 KTS	ND
316	WIND DIRECT TRUE	30.0	ND
317	TRACK ANGLE MAG	5.0°	ND
320	MAG HEADING	15.0°	PFD/ND/RMI'S
321	DRIFT ANGLE	- 10.0°	PFD
322	FLIGHT PATH ANGLE	- 5.0°	PFD
323	FLIGHT PATH ACCEL.	0.02 G	
324	PITCH ANGLE	5.0°	PFD
325	ROLL ANGLE	45.0°	PFD
326	BODY PITCH RATE	10.0°/sec	
327	BODY ROLL RATE	10.0°/sec	
330	BODY YAW RATE	10.0°/sec	
331	BODY LONGIT ACCEL	0.02 G	
332	BODY LATERAL ACCEL	0.10 G	PFD
333	BODY NORMAL ACCEL	0.10 G	
334	PLATFORM HEADING	22.50°	
335	TRACK ANGLE RATE	4.0°/sec	
336	PITCH ATT RATE	10.0°/sec	
337	ROLL ATT RATE	10.0°/sec	
350	ACTION CODE	N/A	
351	IRS MAINT	N/A	
357	ACTION REQUEST	TEST	
360	POTENTIAL VERT SPEED	- 600 FT/mn	VSI
361	INERTIAL ALTITUDE	10000 FT	
362	ALONG TRK HORIZ ACCEL	0.02 G	
363	CROSS TRK HORIZ ACCEL	0.02 G	
364	VERTICAL ACCEL	0.10 G	
365	INERTIAL VERT SPEED	- 600 FT/mn	
366	N - S VELOCITY	200 KTS	
367	E - W VELOCITY	200 KTS	
377	EQUIPMENT ID	04	

DISCRETE WORDS :
THE DISCRETE WORD 277 (IRS TEST WORD) IS USED FOR WRAPAROUND TEST, THE TEST WORD DATA FIELD ALTERNATES BETWEEN THE THREE PATTERNS SHOWN EXCEPT DURING THE REALIGN DECISION SUBMODE AND THE POWER-OFF SUBMODE :

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
P	0	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	SDI	
P	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	SDI	
P	0	0	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	SDI	

DURING SUBMODES, DATA FIELD IS AS FOLLOWS :

BIT	DEFINITION
32	PARITY
31-21	ZERO
20-19	MODE FLAG : 0 0 = POWER-OFF 1 1 = REALIGN DECISION
18-15	MODE TIMER MSB (BCD)
14-11	MODE TIMER LSB (BCD)

This test does not affect the system alignment, but it is inhibited in flight configuration or when ground speed exceeds 20 kts.
In addition "CHECK ATT" and "CHECK HDG" appear respectively on PFD and ND with corresponding warning messages :
* NAV ADC : ATT DISCREPANCY ; HDG DISCREPANCY on left ECAM DU
* MASTER CAUTION lights on instrument panels (3VU and 5VU)
* Single chime sounds

NOTE : For IRS 3 test display on PFD and ND, select SYS 3 on ATT/HDG pushbutton switch on L or R instrument panel.

(b)Monitoring
- Alignment
The alignment procedure starts by an emergency power supply test during the first five seconds.
Program monitoring
The program monitoring is performed by tests on memories for the IRU and the ISDU.
These tests enable checking of :
- the memories at the begining of the alignment and then during navigation
- the instructions of the three microprocessors
- direct and back-up power supply
- the number of pulses delivered by the gyros
- the frequency/voltage converter
- the excitation frequency of the gyros
- the differential plasma current of gyros
- the gyro and accelerometer temperature
- the optical path length
- the accelerometer LED power supply
- the reasonableness of delta V speed increments
- the calibration memory
- the transmitting circuit
- the alignment defects

- the excessive motions during alignment
- the parity of ADS, FMS, ISDU.

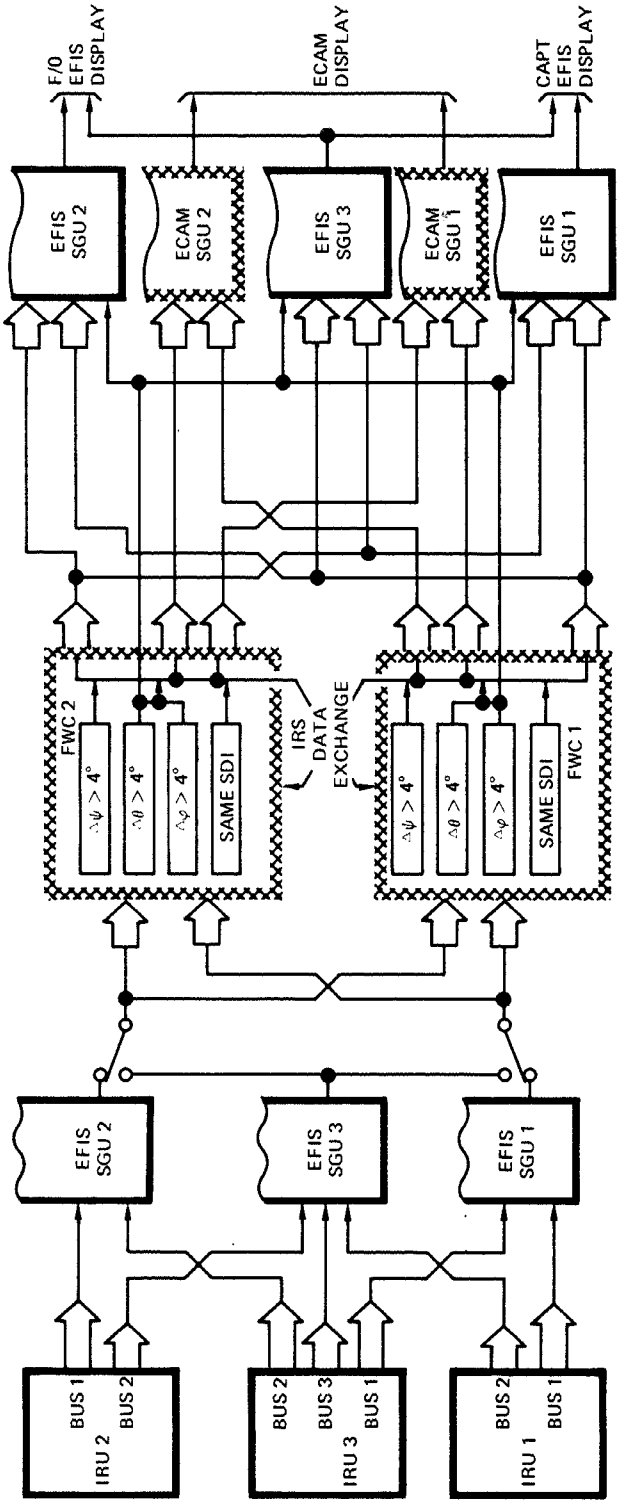
- ISDU software also includes an internal monitoring system, as the IRU
On energization, the RAMs and ROMs are tested.
Then, the following parameters are regularly tested :
- fast wraparound of ARINC ouputs
- parity
- reception intervals
- comparison of SDI code with switch position
- wraparound of IRU data
- power supply.

- An EEROM (Electrical Erasable ROM) records the codes of all the detected failures which occurred during the previous ten flights ; each time the system is energized, the first recording is erased.
An alignment recording (ALIGN RECORD) is performed whenever the system changes from ALIGN mode to NAV or ATT mode, or OFF.
A navigation recording (NAV/ATT RECORD)is performed whenever the system changes from NAV or ATT mode to OFF which includes fast resetting and contains words 1 through 7 of the BITE.
The zone called CAL DATA contains the sensor calibration parameters.
A test (check sum) of this zone is carried out each time the system is energized.
The zone called CAL TRIM DATA contains calibration parameters which are computed during each alignment sequence as a function of the previous alignments.

(c)Failure display

- Self-detected IRS failures
Any detected failure triggers :
- a local warning on the instruments which use data transmitted by the IRS.
- illumination of IRS WARN warning light on MSU in case of a detected IRU failure.
- on instrument panels, MASTER CAUTION lights come on which can be accompanied by illumination of warning lights indicating loss of systems using IRS data.
- an aural warning : single chime
- display of a warning message on left ECAM display unit.
The various messages displayed indicate :
. the failure origin
. the actions to be taken
. the failure consequences
This data will be processed by the crew in accordance with the philosophy developed for the ECAM system.
The following pages describe warnings corresponding to IRS detected failures.

- IRS failures detected by comparison
(Ref. Fig. 049)
The flight warning computers (FWC) compare the attitude and heading data and roll data SDI transmitted by output buses of EFIS SGU1 or 2 which normally recopy data generated by IRU1, 2 respectively.



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IRS Comparison in FWC - Block Diagram
Figure 049

Any IRS1 or IRS2 failure detected by this comparison causes :
- a warning message ATT or HDG to appear on the affected PFD and/or ND when ambiguity is eliminated
- a warning message CHECK ATT or CHECK HDG to appear on the PFD and ND in the case of a comparison between two sources.
- a warning message ATT DISCREPANCY or HDG DISCREPANCY or CAPT-F/O ATT ON SAME SOURCE to be displayed on left ECAM display unit.

This message indicates the action to be taken and failure consequences to the crew.

B. Radio Magnetic Indicator VOR/DME
(1)Magnetic heading information

**ON A/C 001-100,

(Ref. Fig. 050)

**ON A/C 101-200,

(Ref. Fig. 051)

**ON A/C 001-100,

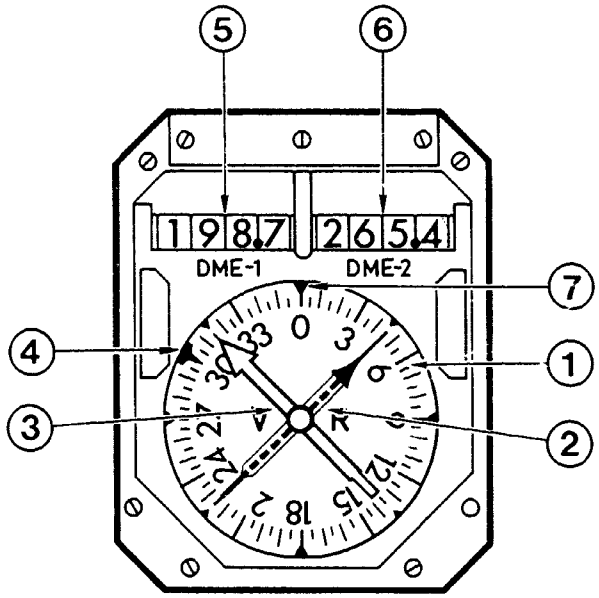
(a)Description (Ref. Fig. 050) (Part A)
Magnetic heading is indicated by a circular dial (item 1) (heading dial) which moves with respect to a fixed index (item 7) (lubber line) and which recopies the heading digital message (ARINC 429 type high speed) received from the IRS1 for Captain's indicator and from the IRS2 for First Officer's indicator in normal operation.

(b)Monitoring
The radio-magnetic indicator provides two types of monitoring :
- monitoring of the digital messages received (external failures)
- internal self-monitoring.

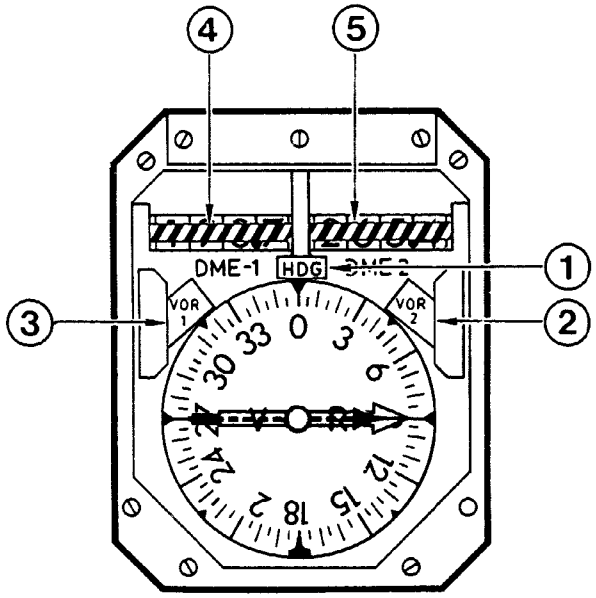
1 Monitoring of the received messages
The indicator detects the following external failures on the digital messages received :
- absence of message
- faulty parity of the message
- message comprising a faulty status matrix
- faulty transmission frequency of the bits
- message comprising no computed data information.

2 Self-monitoring
The indicator detects the following internal failures :
- loss of electrical power supply
- error of permanent recopy of servomotor due to :
  . mechanical jamming
  . failure of recopy synchronizer
  . failure of motor control circuit
  . failure of digital/analog conversion circuit
- failures of digital processing circuits :
  . faulty operation of processing program
  . memory failures.

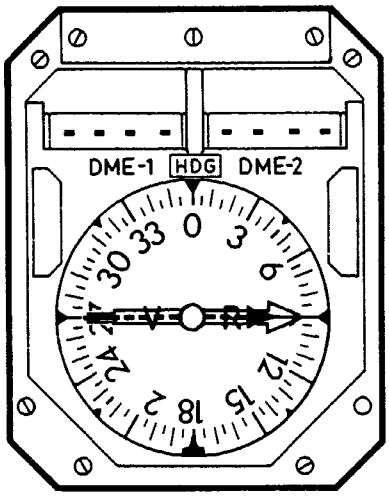
When any of these failures is detected, a fire orange warning flag (item 1) (Ref. Fig. 050) (Part B) with HDG written in black comes into view at the heading dial upper part, two seconds after failure detection.



A) VOR DME RMI
DISPLAY



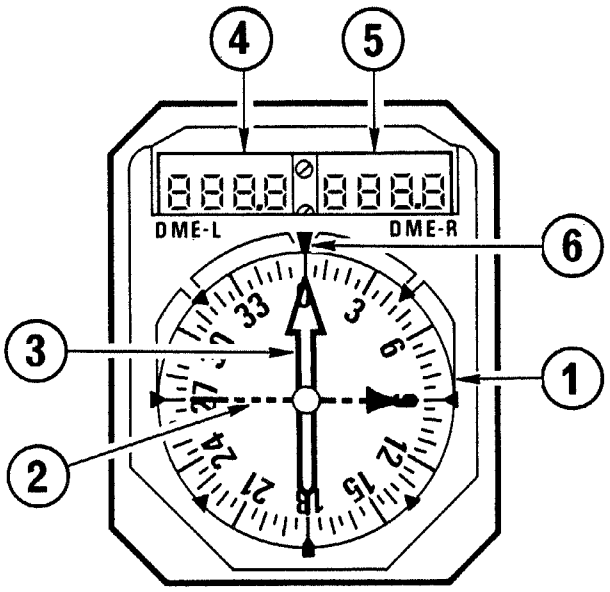
B) VOR/DME RMI
FAILURE CONFIGURATION



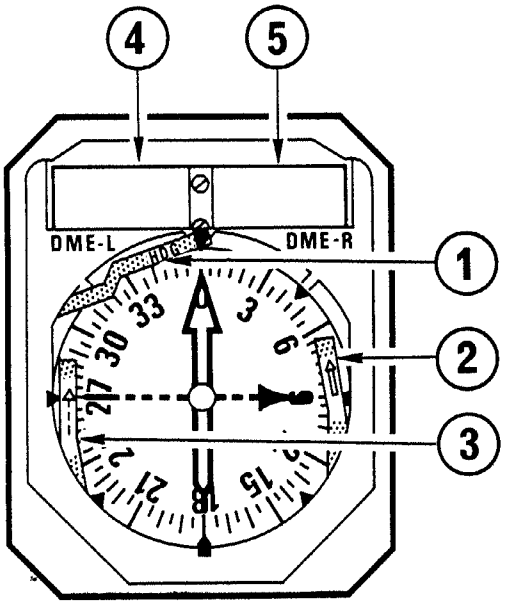
C) VOR/DME RMI
"NO COMPUTED DATA" CONFIGURATION

BM5 34 20 00 0 AGU0 10 05
DM5

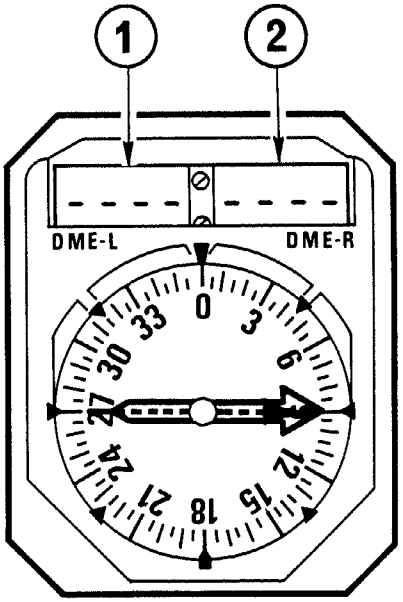
VOR/DME RMI
Figure 050



A/ VOR/DME RMI
DISPLAY



B/ VOR/DME RMI
FAILURE CONFIGURATION



C/ VOR/DME RMI
"NO COMPUTED DATA" CONFIGURATION

BM5 34 20 00 0 AGB0 - 22

VOR/DME RMI
Figure 051

(2)Selected heading information

(a)Description (Ref. Fig. 050)

The selected heading information is given by an arc yellow index (item 4) which moves at the periphery of the heading dial.

The index recopies the selected heading display performed on Flight control unit located on the glareshield.

(b)Monitoring

The indicator provides two types of monitoring :

- monitoring of the received digital messages (external failures)
- internal self-monitoring.

1 Monitoring of the received message

The indicator detects the following external failures on the digital messages received :

- absence of message
- faulty message parity
- message comprising a faulty status matrix
- faulty transmission frequency of bits
- message comprising "No computed data" information.

2 Self-monitoring

The indicator detects the following internal failures :

- loss of electrical power supply
- error of permanent recopy of servomotor due to :
  . failure of recopy synchronizer
  . failure of digital/analog conversion circuit
- failures of digital processing circuits
  . faulty operation of processing program
  . memory failures.

When any of these failures is detected, the selected heading index is positioned at 6 hours if failure does not concern the servomotor mechanical part.

(3)VOR bearing information

(a)Description (Ref. Fig. 050) (Part A)

The bearings are indicated by two concentric pointers which receive data from VOR receiver :

- VOR 1 bearing is indicated by the simple pointer (item 2)
- VOR 2 bearing is indicated by the double pointer (item 3)

(b)Monitoring (Ref. Fig. 050) (Part B and C)

The indicator provides two types of monitoring :

- monitoring of the digital messages received (external failures)
- internal self-monitoring

1 Monitoring of the received messages

The indicator detects the following external failures on the digital messages received :

- absence of message
- faulty message parity
- message comprising a faulty status matrix
- faulty transmission frequency of the bits

2 Self-monitoring

The indicator detects the following internal failures :

- loss of electrical power supply
- error of permanent recopy of servomotor due to :
  . mechanical jamming
  . failure of recopy synchronizer
  . failure of motor control circuit
  . failure of digital/analog conversion circuit
- failures of digital processing circuits
  . faulty operation of processing program
  . memory failure
- failures detected from heading data.

When any of these failures is detected, one of the warning flags marked VOR 1 (item 3) or VOR 2 (item 2) written in black on fire orange background in relation to each bearing channel, comes into view one second after failure detection and VOR pointers are positioned at 3 hours. If the indicator receives NO computed data information in bearing messages, the corresponding VOR pointers are positioned at 3 hours without warning flag coming into view.

(4)DME distance information

(a)Description (Ref. Fig. 050) (Part A)

The DME distances are indicated on magnetic wheel counters which receive data from receivers :

- the left counter (item 5) displays the distance associated with DME1
- the right counter (item 6) displays the distance associated with DME2.

(b)Monitoring

The indicator provides two types of monitoring :

- monitoring of the digital messages received (external failures)
- internal self-monitoring.

1 Monitoring of the received messages

The indicator detects the following external failures on the digital messages received

- absence of message
- faulty message parity
- faulty transmission frequency of bits
- negative DME values.

2 Self-monitoring (Ref. Fig. 050) (Part B and C)

The indicator detects the following internal failures :

- loss of electrical power supply
- failure of center unit (microprocessor, clock, memory).

When any of these failures is detected one of the warning flags (item 4) or (item 5) with white and fire orange stripes in relation to each distance channel, comes into view, 0.5 seconds after failure detection.

If the indicator receives in the distance messages, no computed data information, the counters are masked by a shutter with white dashes on black background.

**ON A/C 101-200,

(a)Description (Ref. Fig. 051) (Part A)
The fixed index (item 6) indicates the magnetic heading of the aircraft on the heading dial (item 1).

(b)Monitoring
The radio-magnetic indicator provides two types of monitoring :
- monitoring of the digital messages received (external failures)
- internal self-monitoring.

1 Monitoring of the received messages
The indicator detects the following external failures on the digital messages received :
- input signal loss
- message validity loss
- computed data loss

2 Self-monitoring
The indicator detects the following internal failures :
- loss of electrical power supply
- servo follow-up error
- software failure

When any of these failures is detected, an amber flag (item 1) (Ref. Fig. 051) (Part B) with HDG written in black comes into view at the heading dial left upper part.

(2)VOR bearing information

(a)Description (Ref. Fig. 051) (Part A)

The bearings are indicated by two concentric pointers which receive data from VOR receiver :

- VOR 1 bearing is indicated by the simple pointer (item 2)
- VOR 2 bearing is indicated by the double pointer (item 3)

(b)Monitoring (Ref. Fig. 051) (Part B)

The radio magnetic indicator provides two types of monitoring :

- monitoring of the digital messages received (external failures)
- internal self-monitoring

1 Monitoring of the received messages

The indicator detects the following external failures on the digital messages received :

- input signal loss
- message validity loss
- computed data loss

2 Self-monitoring

The indicator detects the following internal failures :

- loss of electrical power supply
- servo follow-up error
- software failing

When any of these failures is detected, one of the warning flags with a simple pointer (item 3) or a double pointer (item 2) drawn in black on an amber background in relation to each bearing channel, comes into view.

(3)DME distance information

(a)Description (Ref. Fig. 051) (Part A)

The DME display consists of two windows of fan liquid crystal displays (items 4 and 5) which provide tenths, units, tens and hundreds data. Segment data directs each LCD to display one of ten numerals to indicate distance data.

The DME distances are indicated on magnetic wheel counters which receive data from receivers :

- the left counter (item 4) displays the distance associated with DME1
- the right counter (item 5) displays the distance associated with DME2.

(b)Monitoring

The radio magnetic indicator provides two types of monitoring :

- monitoring of the digital messages received (external failures)
- internal self-monitoring.

1 Monitoring of the received messages

The indicator detects the following external failures on the digital messages received

- input signal loss
- message validity loss
- loss of computed data (except the function "NO computed data")

2 Self-monitoring (Ref. Fig. 051) (Part B)

The indicator detects the following internal failures :

- loss of electrical power supply
- software failing to exercise all functional paths.

When any of these failures is detected, both counters (items 4 and 5) are blanked.

If the indicator receives in the distance messages, NO computed data information, white dashes appear on both counters because input data exceeds range limit of display.

(Ref. Fig. 051) (Part C) (items 1 and 2).

**ON A/C 001-100,

C. Radio Magnetic Indicator : ADF
(1)Magnetic heading information
(a)Description (Ref. Fig. 052) (Part A)
Magnetic heading is indicated by a circular dial (item 1) (heading rose) which moves with respect to a fixed index (item 4) (lubber line) and which recopies the heading digital message (ARINC 429 type high speed) received from the IRS2 for Captain's indicator and from the IRS1 for First Officer's indicator in normal operation.
(b)Monitoring (Ref. Fig. 052) (Part B)
The indicator provides two types of monitoring :
- monitoring of the received digital messages (external failures)
- internal self-monitoring.
1 Monitoring of the received messages
The indicator detects the following external failures on the digital messages received :
- absence of message
- faulty parity of the message
- message comprising a faulty status matrix
- faulty transmission frequency of the bits
- message comprising no computed data information.
2 Self-monitoring
The indicator detects the following internal failures
- loss of electrical power supply
- error of permanent recopy of servomotor due to :
. mechanical jamming
. failure of recopy synchronizer
. failure of motor control circuit
. failure of digital/analog conversion circuit
- failures of digital processing circuits
. faulty operation of processing program
. memory failure.
When any of these failures is detected, a fire orange warning flag (item 5) marked HDG in black comes into view at the heading dial upper part, two seconds after failure detection.

**ON A/C 101-200,

C. Radio Magnetic Indicator : ADF
(1)Magnetic heading information
(a)Description (Ref. Fig. 053) (Part A)
The fixed index (item 4) indicates the magnetic heading of the aircraft on the heading dial (item 1).
(b)Monitoring (Ref. Fig. 053) (Part B)
The indicator provides two types of monitoring :
- monitoring of the received digital messages (external failures)
- internal self-monitoring.
1 Monitoring of the received messages
The indicator detects the following external failures on the digital

messages received :
- input signal loss
- message validity loss
- loss of computed data

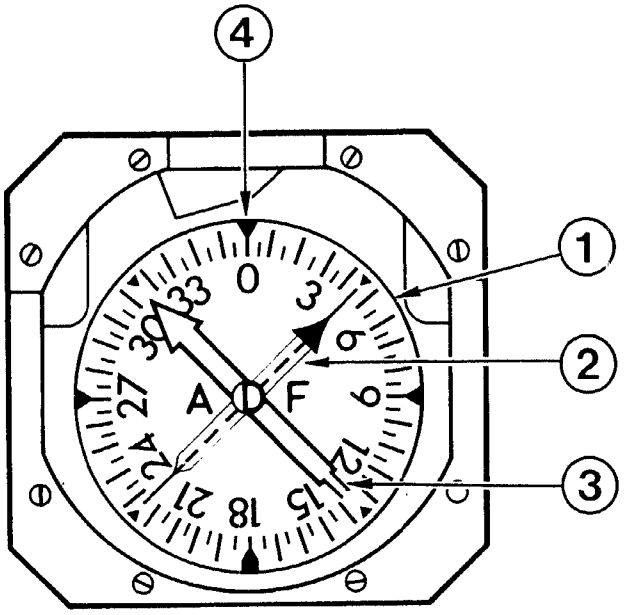
2 Self-monitoring
The indicator detects the following internal failures
- loss of electrical power supply
- servo follow up error
- software failure
When any of these failures is detected, an amber flag(item 5) marked HDG in black comes into view at the heading dial upper part.

**ON A/C 001-100,

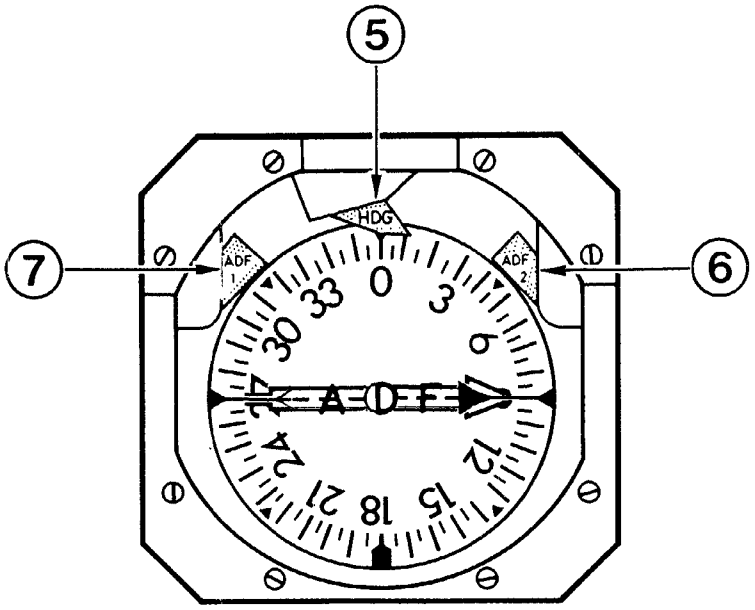
(Ref. Fig. 052)

**ON A/C 101-200,

(Ref. Fig. 053)



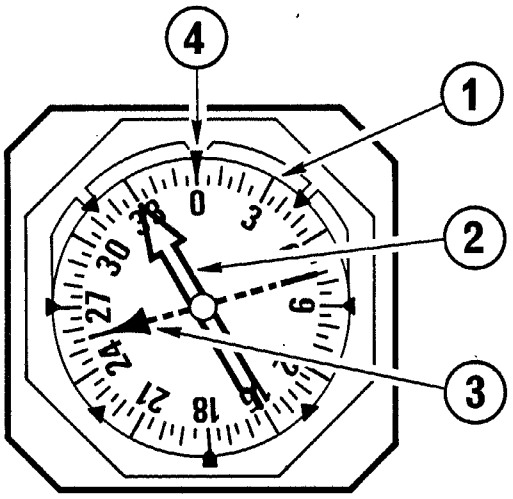
A) ADF RMI
DISPLAY



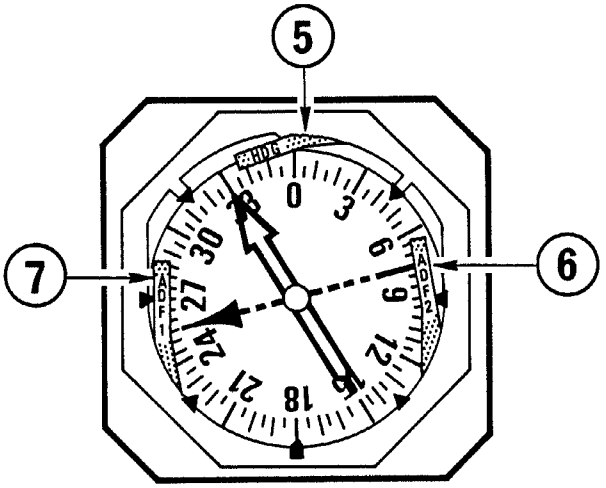
B) ADF RMI
FAILURE CONFIGURATION

BM5 34 20 00 0 AGZ0 09 04
DM5

ADF RMI
Figure 052



A/ ADF RMI DISPLAY



B/ ADF RMI
FAILURE CONFIGURATION

BM5 34 20 00 0 AGC0 22

ADF RMI
Figure 053

**ON A/C 001-100,

(2)ADF bearing information
(a)Description (Ref. Fig. 052) (Part A)
The bearings are indicated by two concentric pointers which receive data from ADF receivers
- ADF 1 bearing is indicated by the simple pointer (item 2)
- ADF 2 bearing is indicated by the double pointer (item 3)

(b)Monitoring (Ref. Fig. 052) (Part B)
The indicator provides two types of monitoring :
- monitoring of the digital messages received (external failures)
- internal self-monitoring.

1 Monitoring of the received messages
The indicator detects the following external failures on the digital messages received :
- absence of message
- faulty message parity
- message comprising a faulty status matrix
- faulty transmission frequency of the bits.

2 Self-Monitoring
The indicator detects the following internal failures :
- loss of electrical power supply
- error of permanent recopy of servomotor due to :
  . mechanical jamming
  . failure of recopy synchronizer
  . failure of motor control circuit
  . failure of digital/analog conversion circuit
- failures of digital processing circuits
  . faulty operation of processing program
  . memory failure.

When any of these failures is detected one of the warning flags marked ADF1 (item 7) or ADF2 (item 6) written in black on fire orange background in relation to each bearing channel comes into view one second after failure detection and ADF pointer is positioned at 3 hours.
If the indicator receives no computed data information in bearing messages, the corresponding ADF pointers are positioned at 3 hours without warning flag coming into view.

**ON A/C 101-200,

(2)ADF bearing information
(a)Description (Ref. Fig. 053) (Part A)
The bearings are indicated by two concentric pointers which receive data from ADF receivers
- ADF 1 bearing is indicated by the simple pointer (item 3)
- ADF 2 bearing is indicated by the double pointer (item 2)

(b)Monitoring (Ref. Fig. 053) (Part B)
The indicator provides two types of monitoring :
- monitoring of the digital messages received (external failures)
- internal self-monitoring.

1 Monitoring of the received messages
The indicator detects the following external failures on the digital messages received :
- input signal loss
- message validity loss
- loss of computed data

2 Self-Monitoring
The indicator detects the following internal failures :
- loss of electrical power supply
- servo follow up error
- software failure

When any of these failures is detected one of the warning flags marked ADF1 (item 7) or ADF2 (item 6) written in black on amber background in relation to each bearing channel comes into view one second after failure detection.

**ON A/C ALL

6. Interfaces

A. Inputs
(1)Discret inputs
The IRU receives the following discrete inputs :
(a)Indication of unit orientation on the aircraft.
(b)Encoding of the number assigned to the unit.
(c)The AIR/GROUND logic controlled by the landing gear.
(d)The IRU is able to select ADC1 or ADC2, either automatically or manually, through pilot's action.
(e)Operation mode control through MSUs.
(f)ISDU operation indication.
(g)The self-test signals enable the ouput parameters to certain values
(2)Binary digital inputs (BNR)
The IRU receives from the selected ADC the following two parameters, encoded on an ARINC 429 low speed bus
- altitude (203)
- true airspeed (210).
(3)BCD digital inputs
The IRU receives from the two FMSs and from the ISDU the following three parameters, encoded in BCD on ARINC 429 low frequency buses.
- set latitude (041)
- set longitude (042)
- set magnetic heading (043) used in ATT mode.

B. Outputs

**ON A/C 001-003,

(Ref. Fig. 054)

**ON A/C 004-200,

(Ref. Fig. 055)

**ON A/C 001-003,

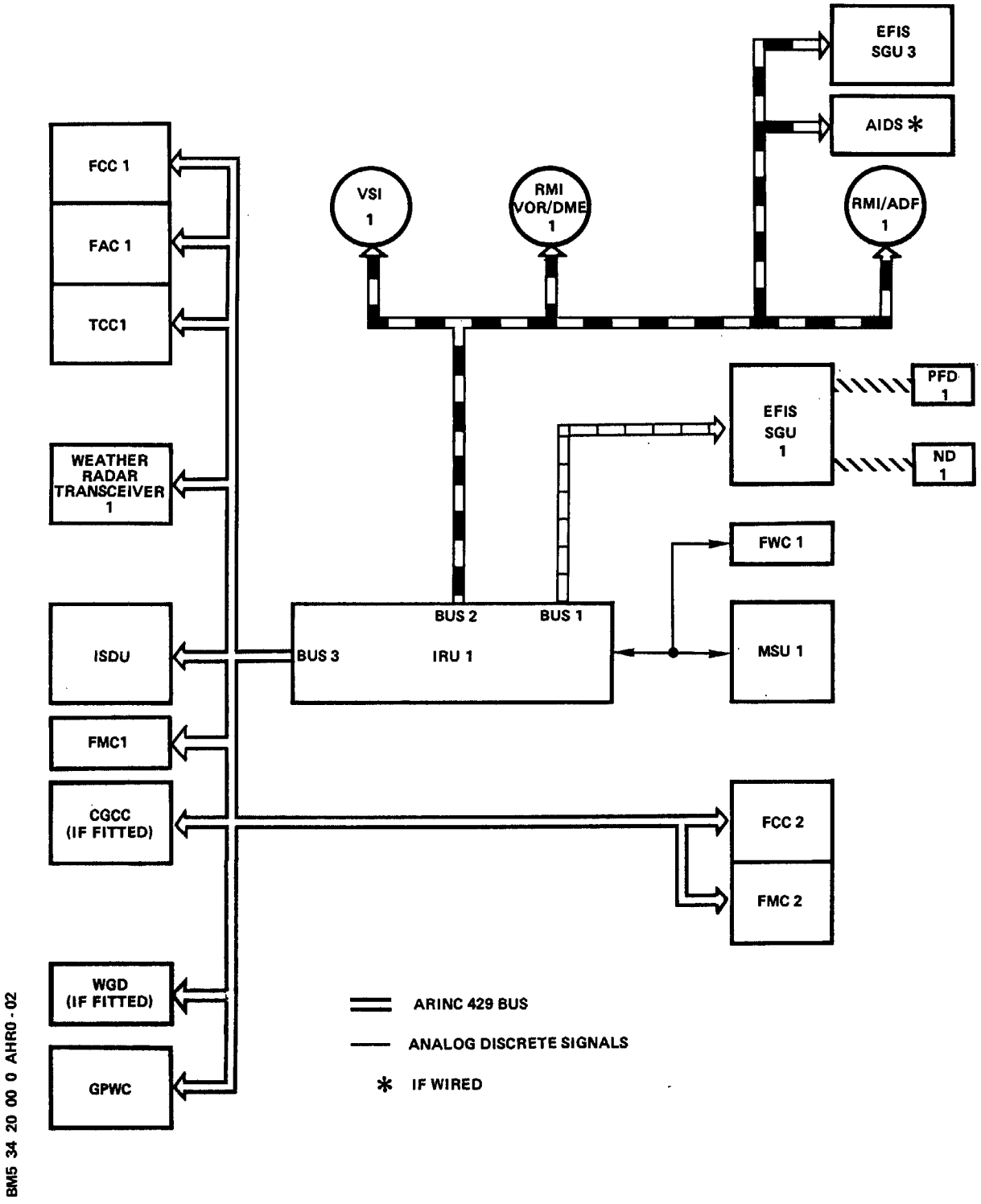
(Ref. Fig. 056)

**ON A/C 004-200,

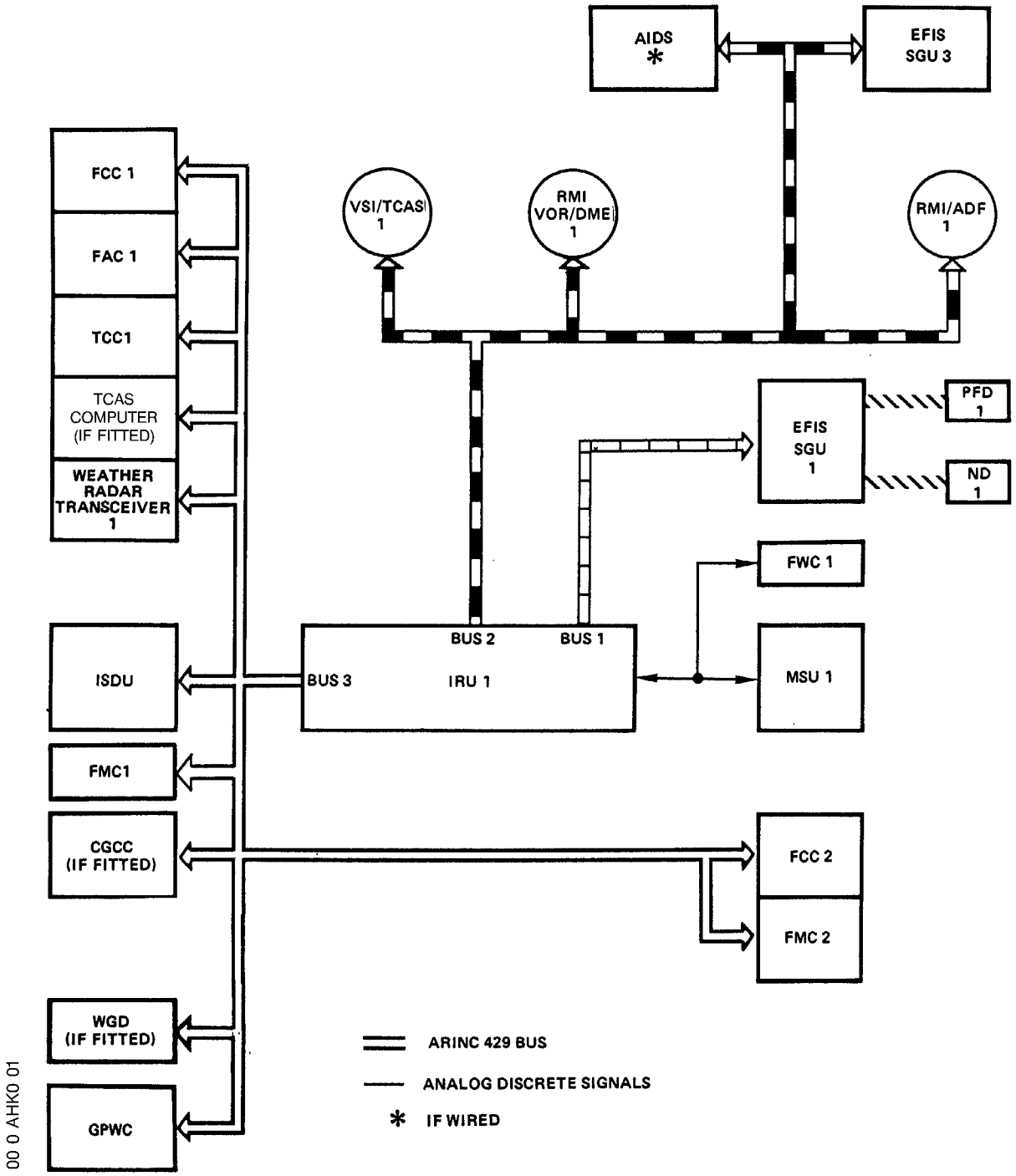
(Ref. Fig. 057)

**ON A/C ALL

(Ref. Fig. 058)
(1)BNR and BCD digital outputs
The outputs are performed on three identical ARINC 429 bus lines at

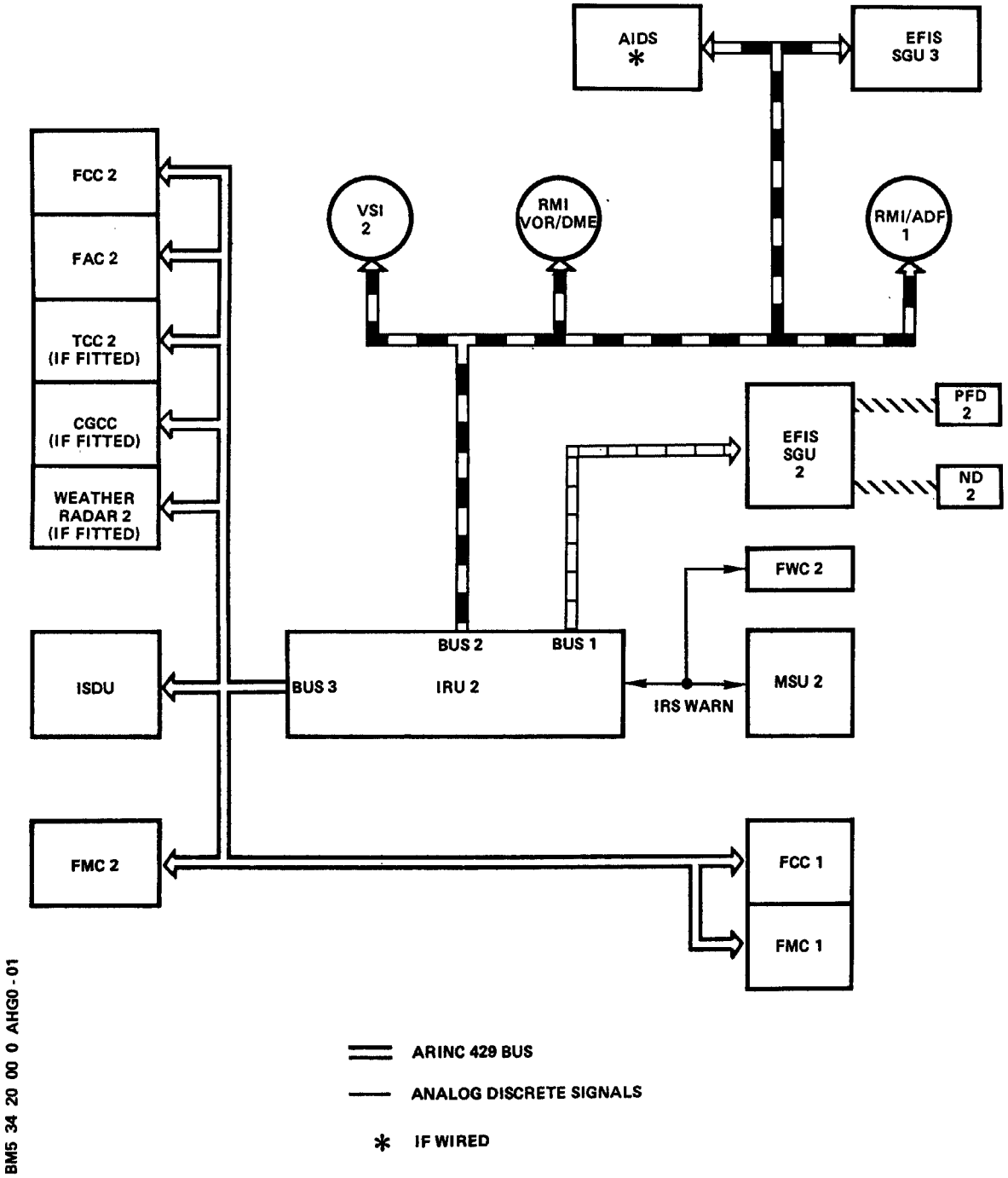


IRU1 Output Distribution
Figure 054



BM5 34 20 00 0 AHK0 01

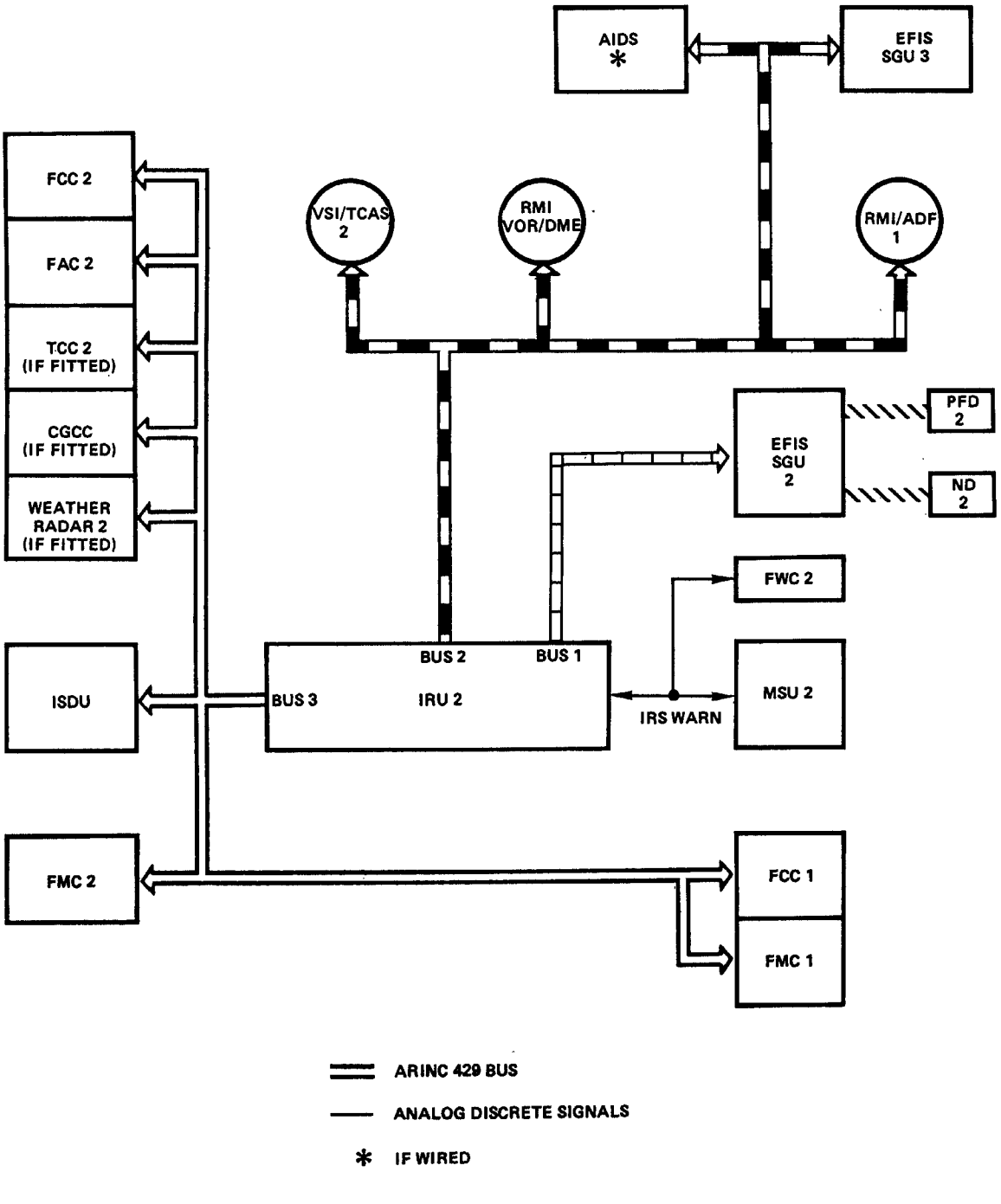
IRU1 Output Distribution
Figure 055



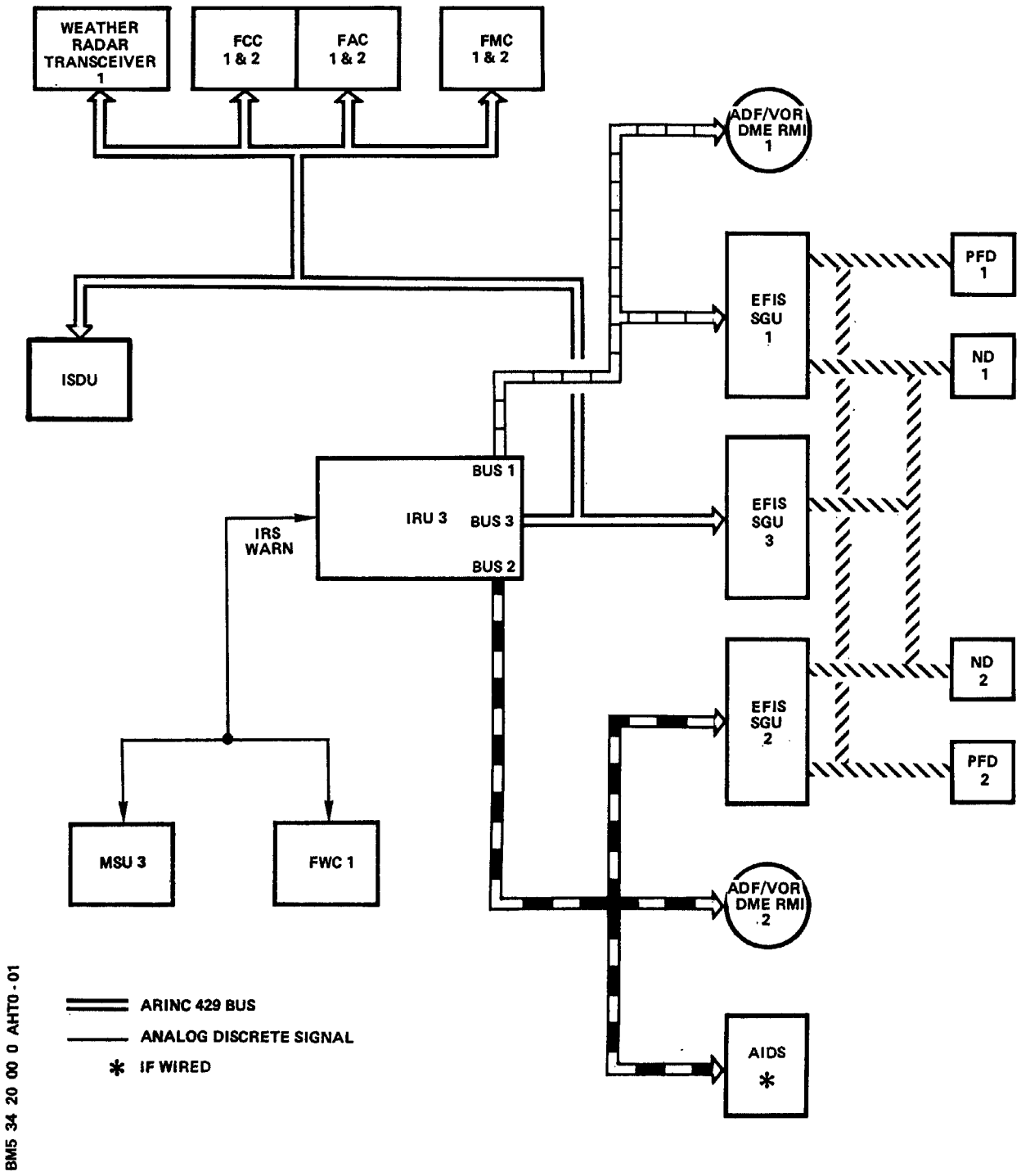
IRU2 Output Distribution
Figure 056

R EFFECTIVITY: 001-003,

PIA



IRU2 Output Distribution
Figure 057



IRU3 Output Distribution
Figure 058

100 kbauds (high speed).
The list of BNR and BCD parameters is given in table 2.
The discrete word 270 structure is given in table 1.

TABLE 1

Bit	Signal	"1" Condition
11	Alignment Not Ready	In Align Submode
12	Rev Att Mode	In Attitude Mode
13	Nav Mode	In NAV Mode
14	Valid Set Heading	A valid set heading has to be input to the IRU. Magnetic heading outputs are no longer being computed, but have the characteristics of a "Free Direction Gyro".
15	Attitude Invalid	Attitude Critical Fault
16	DC Fail	DC Power Less Than 18V
17	On DC	On DC Power
18	ADC Fault	The IRU has detected and ADC input (TAS, ALT and ALT RATE) as FW or NCD. Note functional test data is ignored by the IRU and last valid input is used.
19	IRU Failure	Navigation (Non Critical) Fault
20	DC Fail - On DC	The IRU has detected that a DC fail occurred while on DC from last turn on.
21	Align Fault	The IRU has detected a position miscompare or a Quality of Align fault.
22	No IRS Initial	IRU does not have position data or data received is invalid.
23	Excess Motion Error	X or Y velocity greater than 0.99 ft/sec during align
24	ADC/IRU Fault	No data has been received from the ADC or was received with a parity error.
25	Reserved	
26	Align Time Status	Bits 28 27 26 — Time Until NAV
to		1 1 1 — 7 - 10 minutes
28		1 1 0 — 6 minutes

IRS DIGITAL SUMMARY - OUTPUTS
TABLE 2 - General Data Characteristics

BINARY

LABEL	PARAMETER	UPDATE RATE(Hz)	NUMERIC RANGE	UNITS	SIG BITS	RESOLUTION	POSITIVE SENSE	LABEL
310	PRES POS-LAT	5	±180	DEG	20	0.000172	NORTH FROM ZERO DEG	310
311	PRES POS-LONG	5	±180	DEG	20	0.000172	EAST FROM ZERO DEG	311
312	GROUND SPEED	25	0-4096	KNOTS	15	0.125	ALWAYS POSITIVE	312
313	TRACK ANGLE TRUE	25	±180	DEG	15	0.005493	CW FROM NORTH	313

LABEL	PARAMETER	UPDATE RATE(Hz)	NUMERIC RANGE	UNITS	SIG BITS	RESOLUTION	POSITIVE SENSE	LABEL
314	TRUE HEADING	25	±180	DEG	15	0.005493	CW FROM NORTH	314
315	WIND SPEED	10	0-256	KNOTS	15	0.007813	ALWAYS POSITIVE	315
316	WIND DIRECT TRUE	10	±180	DEG	15	0.005493	CW FROM NORTH	316
317	TRACK ANGLE MAG	25	±180	DEG	15	0.005493	CW FROM NORTH	317
320	MAG HEADING	25	±180	DEG	15	0.005493	CW FROM NORTH	320
321	DRIFT ANGLE	25	±180(1)	DEG	15	0.005493	RIGHT	321
322	FLIGHT PATH ANGLE	25	±180(1)	DEG	15	0.005493	UP	322
323	FLIGHT PATH ACCEL	50	±4	G	15	0.000122	FORWARD	323
324	PITCH ANGLE	50	±180(1)	DEG	15	0.005493	UP	324
325	ROLL ANGLE	50	±180	DEG	15	0.005493	RIGHT WING DOWN	325
326	BODY PITCH RATE	50	±128	DEG/SEC	15	0.003906	UP	326
327	BODY ROLL RATE	50	±128	DEG/SEC	15	0.003906	RIGHT WING DOWN	327
330	BODY YAW RATE	50	±128	DEG/SEC	15	0.003906	NOSE RIGHT	330
331	BODY LONGIT ACCEL	50	±4	G	15	0.000122	FORWARD	331
332	BODY LATERAL ACCEL	50	±4	G	15	0.000122	RIGHT	332
333	BODY NORMAL ACCEL	50	±4	G	15	0.000122	UP	333
334	PLATFORM HEADING	25	±180	DEG	15	0.005493	CW FROM ZERO DEG	334
335	TRACK ANGLE RATE	50	±32	DEG/SEC	15	0.000977	CW	335
336	PITCH ATT RATE	50	±128	DEG/SEC	15	0.003906	UP	336
337	ROLL ATT RATE	50	±128	DEG/SEC	15	0.003906	RIGHT WING DOWN	337
360	POTENT	50	±32768	FT/MIN	15	1.	UP	360
361	INERTIAL ALTITUDE	25	±131072	FT	20	0.125	UP	361
362	ALONG TRK HORIZ ACCEL	50	±4	G	15	0.000122	FORWARD	362
363	CROSS TRK HORIZ ACCEL	50	±4	G	15	0.000122	RIGHT	363
364	VERTICAL ACCEL	50	±4	G	15	0.000122	UP	364
365	INERTIAL VERT SPEED	50	±32768	FT/MIN	15	1	UP	365
366	N-S VELOCITY	10	±4096	KNOTS	15	0.125	NORTH	366
367	E-W VELOCITY	10	±4096	KNOTS	15	0.125	EAST	367

LABEL	PARAMETER	UPDATE RATE(Hz)	NUMERIC RANGE	UNITS	SIG BITS	RESOLUTION	POSITIVE SENSE	LABEL

BCD

LABEL	PARAMETER	UPDATE RATE(Hz)	NUMERIC RANGE	UNITS	SIG BITS	RESOLUTION	POSITIVE SENSE	LABEL
010	PRES POS-LAT.	2	S180-N180	DEG-MIN	6	0.1 MIN	NORTH FROM ZERO DEG	010
011	PRESS POS-LONG.	2	E180-W180	DEG-MIN	6	0.1 MIN	EAST FROM ZERO DEG	011
012	GROUND SPEED	2	0-2000	KNOTS	4	1.0 KT	ALWAYS POSITIVE	012
013	TRACK ANGLE TRUE	2	0-359.9	DEG	4	0.1 DEG	CW FROM NORTH	013
014	MAG HEADING	2	0-359.9	DEG	4	0.1 DEG	CW FROM NORTH	014
015	WIND SPEED	2	0-256	KNOTS	3	1.0 KT	ALWAYS POSITIVE	015
016	WIND DIRECT TRUE	2	0-359	DEG	3	1.0 DEG	CW FROM NORTH	016
044	TRUE HEADING	2	0-359.9	DEG	4	0.1 DEG	CW FROM NORTH	044
041	SET LAT.	*	S180-N180	DEG-MIN	6	0.1 MIN	NORTH FROM ZERO DEG	041
042	SET LONG.	*	E180-W180	DEG-MIN	6	0.1 MIN	EAST FROM ZERO DEG	042
043	SET MAGNETIC HEADING	*	0-359.9	DEG	4	0.1 DEG	CW FROM NORTH	043

OTHER

LABEL	PARAMETER	UPDATE RATE(Hz)	NUMERIC RANGE	UNITS	SIG BITS	RESOLUTION	POSITIVE SENSE	LABEL
270	IRS DISCRETE	2	N/A	N/A	19	N/A	N/A	270
277	IRS TEST	2	N/A	N/A	18	N/A	N/A	277
350	ACTION CODE	2	N/A	N/A	19	N/A	N/A	350
351	MAINT DISCRETE	2	N/A	N/A	19	N/A	N/A	351
357	ACTION REQUEST	2(2)	N/A	N/A	3	N/A	N/A	357
377	EQUIPMENT ID	2	N/A	N/A	19	N/A	N/A	377

(1) OPERATING RANGE = 90 DEG
* Initialization retransmission for verification consists of bit by bit retransmission of data in bursts

DISCRETE WORDS :
THE DISCRETE WORD 277 (IRS TEST WORD) IS USED FOR WRAPAROUND TESTS. THE TEST WORD DATA FIELD ALTERNATES BETWEEN THE THREE PATTERNS SHOWN EXCEPT DURING THE REALIGN DECISION SUBMODE AND THE POWER-OFF SUBMODE :

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	
P	0	0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	SDI
P	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	SDI
P	0	0	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	0	SDI

The discrete word 350 identifies the alphabetical code of label 357. The numbers coded from 01 to 10 of label 357 are coded in bits 23 to 29 of label 350.

Action Codes	Maintenance Message	Description
01	REMOVE IRU	Hard failure ; Remove IRU for maintenance
02	DELAYED MAINT	Soft failure ; Service IRU when convenient
03	ENTER PPOS	Enter present position
04	SELECT ATT	Hard failure ; Select ATTITUDE MODE
05	EXCESS MOTION	Excess motion detected during ALIGN
06	SWITCH ADC	Air Data Computer invalid
07	CHK C/B	Check circuit breakers
08	REMOVE ISDU	Remove ISDU for maintenance
09	ENTER HEADING	Enter heading for ATTITUDE MODE
10		Unassigned TBD

(2)Discrete outputs
The IRU generates indicating and warning discretes through a voltage comprised between 18.5 and 30VDC :
(a)IRS WARN : if this warning does not lead to system switch off, the digital output parameters are encoded as FW (Failure Warning) in their status matrix (SMM).
(b)BATT OPER : indicates that the IRU draws from the DC supply (batteries), due to 115VAC failure.
It also enables battery test during 5 seconds, at the beginning of alignment.
(c)BATT WARN : indicates that DC voltage is below 18VDC.
(d)ALIGN mode : indicates that the system is operating in alignment mode.

C. IRU-ISDU Interface

The IRU and ISDU exchange the following signals :
- ±28VDC and return (ISDU supply)
- ISDU ON discrete output by the ISDU
- ARINC 429 Hi Speed Bus output by the IRU
- ARINC 429 LO Speed Bus output by the ISDU.

The ISDU uses the following parameters, which are generated by the IRU :
- Present Position Latitude (010)
- Present Position Longitude (011)
- Ground Speed (012)
- Track Angle True (013)
- Magnetic Heading (014), in ATT mode only
- Set Latitude (041)
- Set Longitude (042)
- Set Magnetic Heading (043)
- True Heading (044) in NAV mode only
- Software Identification (046) before initialization
- IRS Discrete (270) (ALIGN STATUS)
- IRS Test Word (277) Software number instead of PPOS before initialization
- IRS Maintenance Discrete (350) (Action Code)

THe IRU receives the following parameters from the ISDU :
- IRS Test Word (277) : wraparound
- ISDU Status (270)
- Present Position Latitude (041) | - Initial coordinates
- Present Position Longitude (042) |
- Set Magnetic Heading (043)

Discrete word 270 structure is as follows :

Bits	Significance
1 thru 8	Label
9 thru 14	Not used
15	ISDU RAM Read/Write
16	SDI Error
17 thru 24	Not used
25	ISDU - IRU Long Loop Wraparound Error
26	ISDU Short Loop Wraparound Error
27	ISDU Receiver Time Out (no data from IRU)
28	ISDU Receiver Parity Error
29	ISDU ROM Checksum

Bits	Significance
30, 31	SSM (= 0,0 normal operation)
32	Parity

Discrete Inputs :
MP-A1 is a ground. The discrete inputs enable wiring of various configurations :
Unit orientation :

Pin	Connector towards the front	Connector towards the back	Connector towards the right	Connector towards the left
MP-A2	open	Jump to A1	open	Jump to A1
MP-A3	open	open	Jump to A1	Jump to A1

Source/Destination Identifier :

Pin	Non applicable	Sys 1	Sys 2	Sys 3
MP-A5	open	open	Jump to A1	Jump to A1
MP-A6	open	Jump to A1	open	Jump to A1

AIR/GROUND Logic :

Pin	Ground	Flight
MP-K15	open	aircraft ground

ADC selection :

Pin	Automatic Selection	ADC 1 Manual Selection	ADC 2 Manual Selection
MP-J12 automatic selection	ground	open	open
MP-J13 manual selection	N/A	open	ground

MSU control :

Signal	Pin	OFF Mode	ALIGN/NAV Mode	ATT Mode	N/A
M1	MP-F1	open	ground	open	ground
M2	MP-F2	open	open	ground	ground

ISDU ON discrete signal

The ISDU generates this signal to indicate its status to the IRU :

Pin	ISDU ON	ISDU OFF
MP-D3	ground	open

R

1. Operational Test

A. Reason for the Job
- Test of alignment procedure and ADC switching
- test of attitude and heading comparison warning, through maintenance panel and bite test IRS 1, IRS 2
- bite test of IRS3 and switching
- test of warnings : ECAM message, MASTER CAUTION lights, annunciators on MSU and aural warnings
- test of lighting and display : with integral lighting test of ISDU.
- test of attitude comparison warning through EFIS CONTROL PANEL

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

C. Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(1)Job set-up
- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION, ADS and ECAM:
- Make certain that AP1 and AP2 engage levers are in OFF position.
- Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (aircraft in ground configuration).
- Make certain that CAPT and F/O SWITCHING ATT/HDG, ADC INST and EFIS/SGU pushbutton switches are in normal position (released).
- On Captain and First Officer EFIS control panels, make certain that PLAN mode is not selected.

NOTE : In case of use a stored IRU containing different PPOS that present A/C PPOS, ALIGN MODE annunciator will flash with an action code 03 displayed on ISDU - In this case, it is necessary to re-enter the A/C present PPOS until the IRU memory accepts the new PPOS.

(2)Test of Alignment procedure and ADC switching

R CAUTION : THE SELECTOR SWITCH ON THE MSU MUST FIRST BE PULLED AND THEN
R TURNED TO LEAVE THE NAV POSITION. IN NAV POSITION, IF YOU TRY
R TO TURN THE SELECTOR SWITCH BEFORE YOU PULL IT, YOU CAN DAMAGE
R THE MSU.

NOTE : During alignment sequences, aircraft must not be moved.

ACTION	RESULT
1. On overhead panel - place MSU1, MSU2, MSU3 selector switch in OFF position - place DSPL SEL selector switch on ISDU in HDG/STS position	
NOTE : The test described below concerns IRU1. For IRU2 and IRU3 tests, which are identical, refer to information between parentheses.	
R 2. On panel 402VU (406VU, 402VU or 406VU) - ATT HDG pushbutton switch is released (released ; selected)	
3. Place SYS selector switch of ISDU in any R position 1 (2,3).	
R 4. Place MSU1 (2,3) selector switch R in NAV position	Check that : On MSU1 (2, 3) - BAT OPER annunciator comes on, then goes off after 5 seconds and ALIGN MODE annunciator comes on. On left ECAM display unit in MEMO mode - IRS in ALIGN message is displayed. On CAPT and F/O PFDs - ATT failure warning message goes off - ATTITUDE Data comes into view

For reference only, action codes appearing when DSPL SEL selector switch on ISDU is in HDG/STS position (left number in right displays of ISDU).

ISDU ACTION CODE	CREW ACTION REQUEST	MALFUNCTION
01	REMOVE IRU	IRU HARD FAILURE
02	DELAYED MAINTENANCE	IRU SOFT FAILURE *
03	ENTER P. POS.	NO INITIALIZATION DATA ENTERED
04	SELECT ATT	IRU HARD FAILURE (SEL ATT MODE)
05	EXCESS MOTION	A/C MOTION TOO GREAT FOR SUCCESSFUL ALIGNMENT
06	SWITCH ON ADC	AIR DATA COMPUTER INVALID
07	CHECK C/B	POWER PROBLEM CHECK IRS C/BS
08	REMOVE ISDU	ISDU FAILURE
09	ENTER HEADING	ENTER HEADING FOR ATTITUDE MODE
10		UNASSIGNED TBD

ACTION	RESULT
NOTE : Status number decreasing from 10 to 1 on ISDU (right number) right display corresponds to time (in mn.) which remains to be run in submode Align. * Malfunction that does not affect system operation now but that should be corrected at an opportune time.	
5. Place DSPL SEL selector switch on ISDU in PPOS position - using ISDU keyboard, enter local present position	About 6.5 minutes after switch on : Check that on CAPT and F/O NDs - HDG failure warning message goes off - Heading data (Heading dial) comes into view Check that on CAPT (F/O) VOR/DME RMI, F/O (CAPT) ADF RMI - HDG failure warning flag goes out of view. - Heading data comes into view. About ten minutes after switch on : On MSU1 (2 ; 3) check that - ALIGN MODE annunciator goes off On the left ECAM display unit - IRS IN ALIGN message disappears
6. Place DSPL SEL selector switch on ISDU in HDG/STS position.	On ISDU check that - status number in the right of the right display is blank (NAV mode).
NOTE : To check ADC to IRS3 switching, perform a second time the following double procedure, selecting CAPTAIN SWITCHING ATT/HDG (F/O SWITCHING ATT HDG) and SYS3 on ISDU.	
7. Open ADS/ADC1/115VAC circuit breaker 9FL1 (ADS/ADC2/115VAC/9FL2) located on panel 22VU (21VU), line 208/B19 (105/E10).	On ISDU, check that on right display the left number (Action code) is 06.
8. On panel 402VU (406VU) - press ADC INST pushbutton switch - release ADC INST pushbutton switch. - check that ATT HDG pushbutton switch is released	On IDSU check that ACTION CODE 06 disappears.

ACTION	RESULT
9. Close circuit breaker 9FL1 (9FL2)	

R WARNING : MAKE SURE THAT ALL PERSONS ARE AWAY FROM THE SATCOM ANTENNAS (MORE
R THAN 3 METERS) WHEN YOU DO THIS TEST. THE SATCOM ANTENNAS USE HIGH
R POWER WHEN THEY TRANSMIT AND CAN CAUSE INJURY TO PERSONS.

(3)BITE test of IRS1 and IRS2 through maintenance panel, attitude and heading comparison warning.

R CAUTION : THE SELECTOR SWITCH ON THE MSU MUST FIRST BE PULLED AND THEN
R TURNED TO LEAVE THE NAV POSITION. IN NAV POSITION, IF YOU TRY
R TO TURN THE SELECTOR SWITCH BEFORE YOU PULL IT, YOU CAN DAMAGE
R THE MSU.

NOTE : The test described below concerns IRS1. For IRS2 test which is identical, refer to information between parentheses.

NOTE : Checking all ARINC 429 bus lines between IRS and EFIS SGUs will be achieved if the same test is performed on IRS1 (2), CAPTAIN (F/O) SWITCHING EFIS/SGU pushbutton switch being pressed.

ACTION	RESULT
1. On overhead panel - place MSU1, 2 and 3 selector switch in NAV position.	
2. On panel 47OVU - press and hold IRS1 (2) test push-button switch	Check that on CAPT (F/O) PFD, indications are : roll 45° right, pitch 5 ° up slip to left. On CAPT (F/O) ND - Ground speed GS indication is 200 kts - Heading indication is 15°. On CAPT (F/O) VOR/DME RMI, F/O (CAPT) ADF RMI - Heading indications are 15°.
**ON A/C 001-003,	On CAPT (F/O) VSI - Vertical speed indication is -600 ft/mn
**ON A/C 004-200,	On CAPT (F/O) VSI/TCAS

ACTION	RESULT
	- Vertical speed indication is -600 ft/mn
**ON A/C ALL	
	On F/O (CAPT) PFD - check that CHECK ATT message is displayed
	On F/O (CAPT) ND - check that CHECK HDG message is displayed
	On left ECAM DU the following messages are displayed - NAVADC ATT DISCREPANCY HDG DISCREPANCY On main instrument panels 3VU and 5VU - MASTER CAUTION lights come on and single chime sounds.

NOTE : Check that CHECK HDG and HDG DISCREPANCY messages do not appear if the A/C HDG is equal to 15° ±4.

3. On overhead panel on ISDU - place SYS DSPL selector switch in position 1(2)	On ISDU :
- place DSPL SEL selector switch in TRK/GS position	Check that left display indicates 0.0 and right display indicates 200
- place DSPL SEL selector switch in HDG/STS position	Check that left display indicates 10.0
4. Release IRS1(2) test pushbutton switch	All the instruments come back to their initial position.

(4)BITE test of IRS3 and IRS switching

R CAUTION : THE SELECTOR SWITCH ON THE MSU MUST FIRST BE PULLED AND THEN
R TURNED TO LEAVE THE NAV POSITION. IN NAV POSITION, IF YOU TRY
R TO TURN THE SELECTOR SWITCH BEFORE YOU PULL IT, YOU CAN DAMAGE
R THE MSU.

NOTE : During following test check that captain priority operates when F/O SWITCHING ATT-HDG is on and CAPT SWITCHING ATT-HDG is being

pressed.

ACTION	RESULT
1. On overhead panel - place **MSU1, MSU2, MSU3** selector switch in **NAV** position.	
2. On **ISDU,** place **SYS DSPL** selector switch in position **3** and **DSPL SEL** selector switch in **TRK/GS** position.	
3. On panel 402VU (406VU) - press **CAPT (F/O) SWITCHING ATT HDG** pushbutton switch	Check that : On **CAPT (F/O)** switching **ATT HDG** pushbutton switch - **SYS3** legend comes on On **F/O (CAPT)** switching **ATT HDG** pushbutton switch - **CAPT/3 (F/O/3)** legend comes on
4. On panel 470VU - press and hold **IRS3** test pushbutton switch	Check that : On **CAPT (F/O) PFD** indications are : roll 45° right pitch 5° up slip to left On **F/O (CAPT) PFD** - **CHECK ATT** message is displayed On **F/O (CAPT) ND** - **CHECK HDG** message displayed On left **ECAM DU** the following messages are displayed - **NAV ADC** **ATT DISCREPANCY** **HDG DISCREPANCY** On main instrument panels **3VU** and **5VU** - **MASTER CAUTION** lights come on and single chime sounds. On **CAPT (F/O) ND** - Ground speed indication is 200 kts - Heading indication is 15°. On **CAPT (F/O) VOR/DME RMI, F/O (CAPT) ADF RMI** On **ISDU,** left display indicates 0.0 and right display indicates 200.
5. On panel 402VU (406VU) - press to release **CAPT (F/O) ATT**	

ACTION	RESULT
HDG pushbutton switch	
6. Starting from step 3, perform test a second time with information between parentheses.	
7. On ISDU, place DSPL SEL selector switch in HDG/STS position.	Check that left display indicates 10.0
8. Release IRS3 test pushbutton switch.	

(5)Test of warnings

R CAUTION : THE SELECTOR SWITCH ON THE MSU MUST FIRST BE PULLED AND THEN
R TURNED TO LEAVE THE NAV POSITION. IN NAV POSITION, IF YOU TRY
R TO TURN THE SELECTOR SWITCH BEFORE YOU PULL IT, YOU CAN DAMAGE
R THE MSU.

NOTE : All three procedures are identical up to step 7; Procedure is described for IRS1 ; To perform IRS2 or IRS3 test, refer to information between parentheses.

ACTION	RESULT
1. On overhead panel - place MSU1 (2, 3) selector switch in OFF position and wait at least 25 seconds	Check that - during the first 5 seconds . the left display indicates OFF . the right display indicates a count-down from 5 seconds to 0 second - during the following 20 seconds . left display indicates OFF . the right display indicates a count-down from 20 seconds to 0 second
2. Open NAVIGATION/IRS1/115VAC circuit breaker 312FP1 (NAVIGATION/IRS2/115VAC/312FP2; NAVIGATION/IRS3/115VAC/312FP3) line 208/B22 (105/E12 ; 208/B23), on panel 22VU (21VU ; 22VU)	
3. On MSU1 (2, 3) - place selector switch in NAV position	Check that - On MSU1 (2, 3) . 2 seconds after, BAT OPER annunciator comes on ; . 5 seconds after, ALIGN MODE annunciator comes on and IRS WARN annunciator flashes. - On main instrument panels 3VU and

ACTION	RESULT
	5VU : . MASTER CAUTION lights come on and single chime sounds. - On left ECAM DU the following message is displayed : NAV ADC IRS1 (2, 3) FAULT . 10 seconds after BAT OPER warning horn sounds in nose landing gear well and INS/IRS RACK VENT warning light comes on on landing gear leg.
4. Close circuit breaker 312FP1 (2, 3)	Check that - On MSU1 (2, 3) BAT OPER annunciator goes off - horn stops.
5. On MSU1 (2, 3) - place selector switch in ATT position	Check that : - IRS WARN annunciator goes off - On ISDU, right display indicates ATT . 10 seconds after, ALIGN MODE annunciator goes off and all warnings (aural and visual) stop.
6. On MSU1 (2, 3), place selector switch in OFF position and wait at least 20 seconds.	On ISDU, check that : - right display indicates OFF - left display indicates a count-down from 20 seconds to 0 second. Then ISDU display goes off.
7. On MSU1 (2, 3) - place selector switch in NAV position and wait at least 5 seconds	Check that on MSU1 (2, 3) : - ALIGN MODE annunciator comes on - BAT OPER annunciator comes on during 5 seconds then goes off.
7. Open NAVIGATION/IRS1/BAT circuit breaker 313FP1 (NAVIGATION/IRS2/BAT, 313FP2 ; NAVIGATION/IRS3/BAT, 313FP3) location A/8 (line 105/E13, location A/7) on panel 281VU (21VU; 281VU)	Check that on MSU1 (2, 3) - BAT WARN annunciator comes on

ACTION	RESULT
8. Close circuit breaker 313FP1 (2,3)	- BAT WARN annunciator goes off.
NOTE : The following steps concern only F/O side.	
9. On panels 402VU and 406VU - place ATT-HDG pushbutton switch in normal position (released).	
10. On panel 21VU open NAVIGATION/F/O/ INST SW circuit breaker 5FN2 line 104/F8.	Check that, on MSU2, BAT WARN annunciator comes on after a 30 second time delay.
11. Close circuit breaker 5FN2 on 21VU	BAT WARN goes off.
12. On panel 22VU, open ELEC/ESS TR REV CURRENT SENSOR circuit breaker 20PC, line 206/D16	Check that, on MSU3, BAT WARN annunciator comes on after a 30 second time delay.
13. On panel 402VU press ATT HDG pushbutton switch	BAT WARN goes off.
14. Close circuit breaker 20PC and release ATT HDG pushbutton switch	BAT WARN remains off.

(6)Test of lighting and display

ACTION	RESULT
1. On overhead panel, on ISDU - place DSPL SEL selector switch in TEST position	On ISDU, check all display lights and cue lights to ensure that no is burned out On ENT and CLR pushbutton switches a green highlighter bar is on.

(7)Test of attitude comparison warning through EFIS CONTROL PANEL

R CAUTION : THE SELECTOR SWITCH ON THE MSU MUST FIRST BE PULLED AND THEN
R TURNED TO LEAVE THE NAV POSITION. IN NAV POSITION, IF YOU TRY
R TO TURN THE SELECTOR SWITCH BEFORE YOU PULL IT, YOU CAN DAMAGE
R THE MSU.

NOTE : The test described below concerns CAPT attitude comparison warning; for F/O attitude comparison warning test which is identical, refer to information in parentheses.

ACTION	RESULT
1. On overhead panel, on MSU1, MSU2 and MSU3	

ACTION	RESULT
- place mode selector switch in NAV position and wait until attitude data comes into view	
2. On glareshield, on CAPT (F/O) EFIS control panel	Check that :
- place and hold mode selector switch in TEST position	- on CAPT (F/O) EFIS control panel, display window displays 888 and lower strip on pushbutton switches comes on. - on CAPT and F/O PFDs, CHECK ATT red warning message flashes On left ECAM DU the following messages are displayed - NAV ADC ATT DISCREPANCY On main instrument panels 3VU and 5VU - MASTER CAUTION lights come on and single chime sounds
- release mode selector switch	- all displays and strips go off.

D. Close-Up

R CAUTION : THE SELECTOR SWITCH ON THE MSU MUST FIRST BE PULLED AND THEN
R TURNED TO LEAVE THE NAV POSITION. IN NAV POSITION, IF YOU TRY TO
R TURN THE SELECTOR SWITCH BEFORE YOU PULL IT, YOU CAN DAMAGE THE
R MSU.

(1) On overhead panel, on MSU1, MSU2 and MSU3, place mode selector switch in OFF position.

NOTE : When placing mode selector switch on MSU in OFF position, IRS WARN light may come on for 20 seconds, or may not come on at all : both results are normal.

(2) De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(3) Restore system and aircraft to normal operating condition.

INERTIAL SENSOR DISPLAY UNIT (311FP) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-25-00, P. Block 501	Inertial Reference System

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/IRS 2/115VAC	312FP2	105/E12
21VU	NAVIGATION/IRS 2/BAT	313FP2	105/E13
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS 1 115VAC	312FP1	208/B22
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS 3/ 115VAC	312FP3	208/B23
281VU	IRS 1/BAT	313FP1	A8
281VU	IRS 3/BAT	313FP3	A7
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77

B. Removal

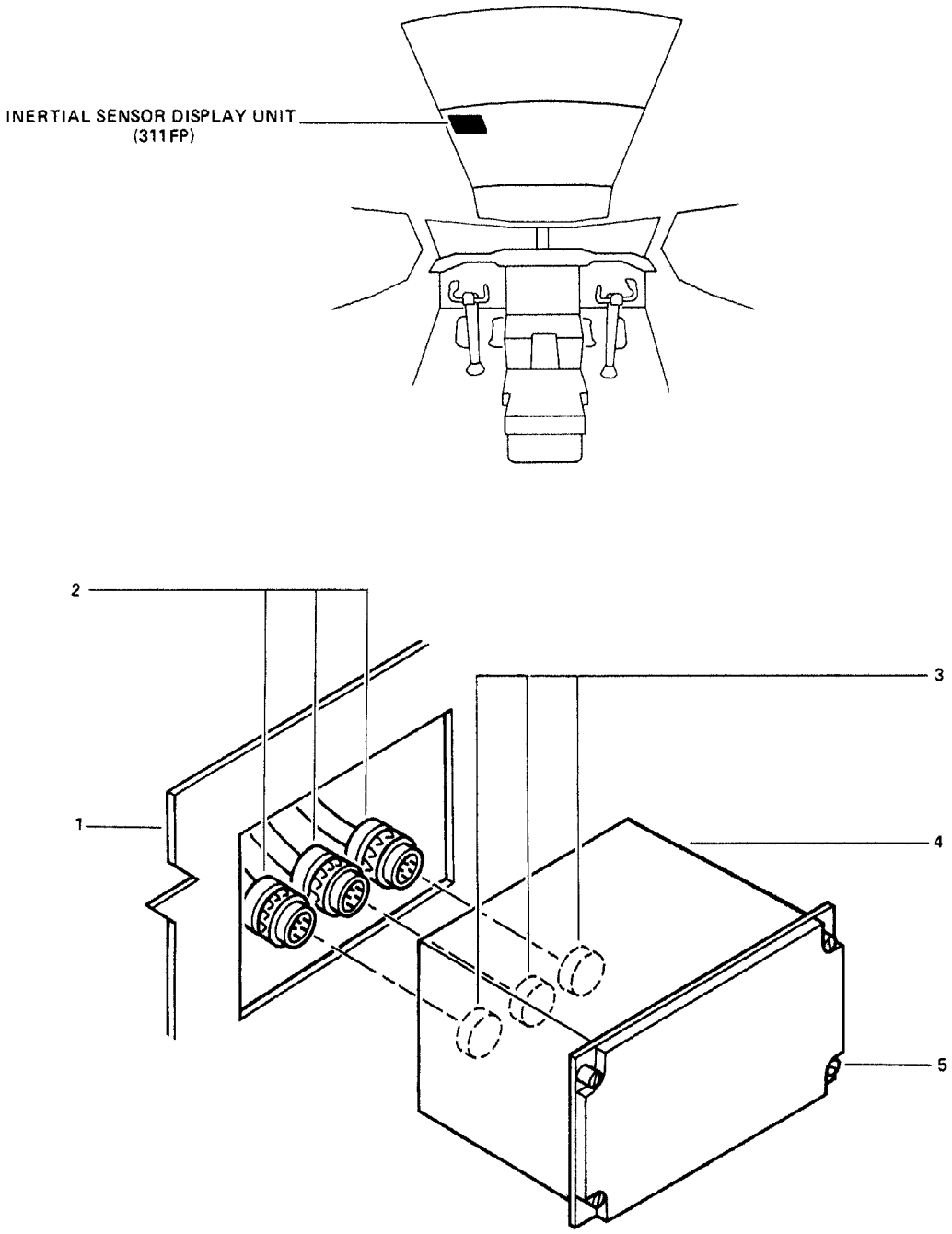
(1)Turn-to-release the four dzus fasteners (5) securing display unit (4).
(2)Remove display unit (4) from housing (1).
(3)Disconnect and cap electrical connectors (2) and (3).
(4)Remove display unit (4).

C. Installation

(1)Clean and inspect display unit (4) interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (2) and (3).
(3)Connect electrical connectors (2) to corresponding connectors (3).
(4)Engage display unit (4) in housing (1).
(5)Turn-to-lock the four dzus fasteners (5).
(6)Remove safety clips and tags and close circuit breakers 313FP1, 312FP1, 312FP2, 313FP2, 312FP3, 313FP3 and 3LF.

D. Test

Carry out BITE test of IRS1, IRS2 and IRS3
(Ref. 34-25-00, P. Block 501, Operational test of IRS) : read only values displayed by inertial sensor display unit.



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Inertial Sensor Display Unit
Figure 401

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

INERTIAL SYSTEM DISPLAY UNIT - DEACTIVATION/REACTIVATION

Ref. MMEL Sect. 1-34, Item 11

CAUTION : THIS PROCEDURE IS TO BE USED ACCORDING TO THE REQUIREMENTS OF THE MMEL.

1. Deactivation

A. Reason for the Job

To inform the flight crew in case of dispatch with ISDU inoperative.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Adhesive tape

C. Procedure

On ISDU SYS Rotary Selector, put an adhesive tape to prevent its operation.

MODE SELECTOR UNIT (310FP1, 310FP2, 310FP3) - REMOVAL/INSTALLATION

1. Equipment and Materials

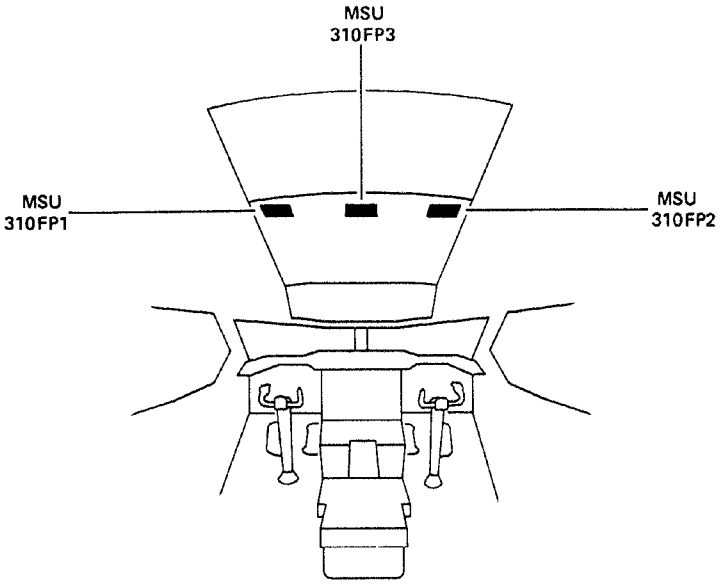
ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-25-00, P. Block 501 (Ref. Fig. 401)	Inertial Reference System

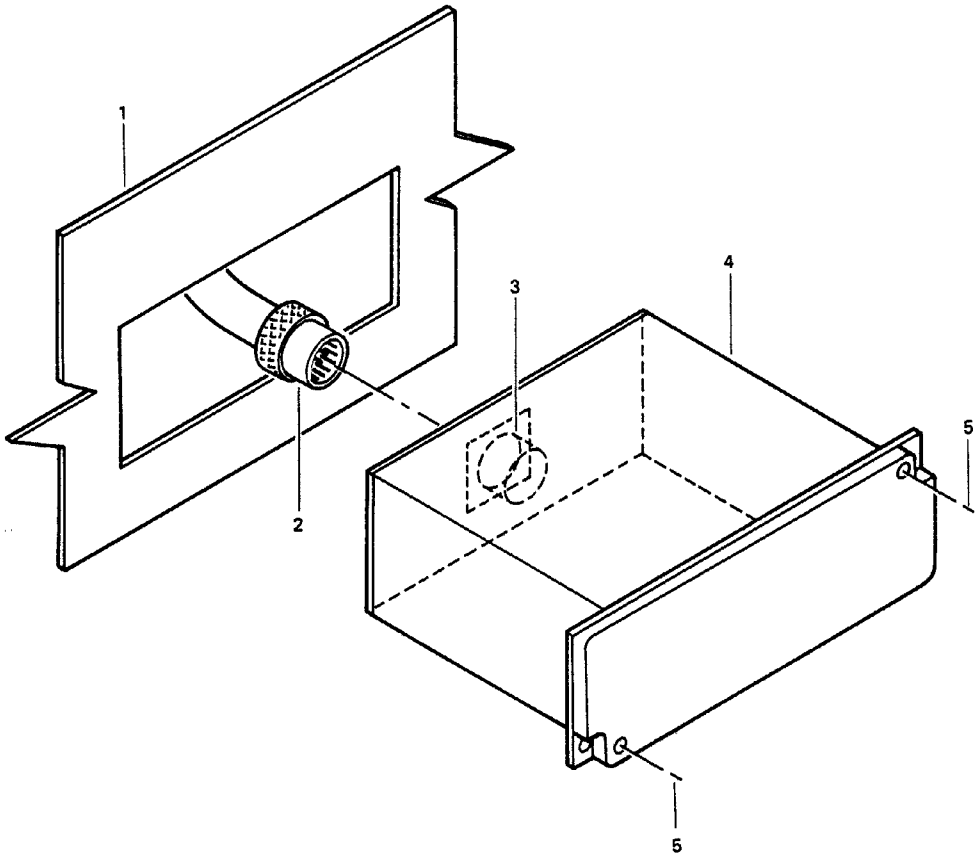
2. Procedure

A. Job Set-Up

(1) According to MSU to be removed, open, safety and tag the following circuit breakers (MSU1 : 312FP1, 313FP1, 3LF ; MSU2 : 312FP2, 313FP2, 3LF ; MSU3 : 312FP3, 313FP3, 3LF) :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/IRS2/115VAC	312FP2	105/E12
21VU	NAVIGATION/IRS2/BAT	313FP2	105/E13
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS1/115VAC	312FP1	208/B22
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS3/115VAC	312FP3	208/B23
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77
281VU	IRS 1/BAT	313FP1	A 8
281VU	IRS 3/BAT	313FP3	A 7





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Mode Selector Unit - Removal/Installation
Figure 401

B. Removal
(1)Unscrew the two Dzus fasteners (5) on MSU (4).
(2)Extract MSU (4) from housing.
(3)Disconnect and cap electrical connectors (2) and (3).
(4)Remove MSU (4).

C. Installation
(1)Clean and inspect MSU adjacent area.
(2)Remove blanking caps from electrical connectors (2) and (3).
(3)Connect electrical connector (2) to electrical connector (3).
(4)Slide MSU (4) into housing (1).
(5)Tighten Dzus fasteners (5).
(6)Remove safety clips and tags and close the following circuit breakers according to the removed MSU (MSU1 : 312FP1, 313FP1, 3LF ; MSU2 : 312FP2, 313FP2, 3LF ; MSU3 : 312FP3, 313FP3, 3LF).

D. Test
Carry out test of alignment procedure up to step 4 (IRS operational test, Ref. 34-25-00, P. Block 501).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

INERTIAL REFERENCE UNIT (301FP1, 301FP2, 301FP3) - REMOVAL/INSTALLATION

R CAUTION : DO NOT REMOVE THE RACK (MOUNT) OF THIS UNIT.
PRECISION ADJUSTMENT IS NECESSARY TO INSTALL THE RACK (MOUNT) CORRECTLY. THE MANUFACTURER DOES THIS ADJUSTMENT BEFORE DELIVERY OF THE AIRCRAFT.

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-25-00, P. Block 501 (Ref. Fig. 401)	Inertial Reference System

2. Procedure

A. Job Set-Up

(1)According to IRU to be removed, open, safety and tag the following circuit breakers (IRU 1 : 312FP1, 313FP1 ; IRU 2 : 312FP2, 313FP2 ; IRU 3 : 312FP3, 313FP3) :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/IRS2/115VAC	312FP2	105/E12
21VU	NAVIGATION/IRS2/BAT	313FP2	105/E13
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS1/115VAC	312FP1	208/B22
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS3/115VAC	312FP3	208/B23
281VU	IRS1/BAT	313FP1	A8
281VU	IRS3/BAT	313FP3	A7

(2)Open access door 121BL and gain access to avionics compartment.

(3)In avionics compartment, to gain access to IRU1 and IRU3, proceed as follows :

(a)Unscrew the twelve Dzus fasteners (2).

(b)Remove protective cover (1) from IRU1 and IRU3.

B. Removal

(1)Unscrew knurled retaining nuts (5) located at front of mount (6) and swing them downwards.

(2)Withdraw IRU (3) from mount (6), taking care not to damage electrical connectors (4) and (7).

(3)Cap electrical connectors (4) and (7).

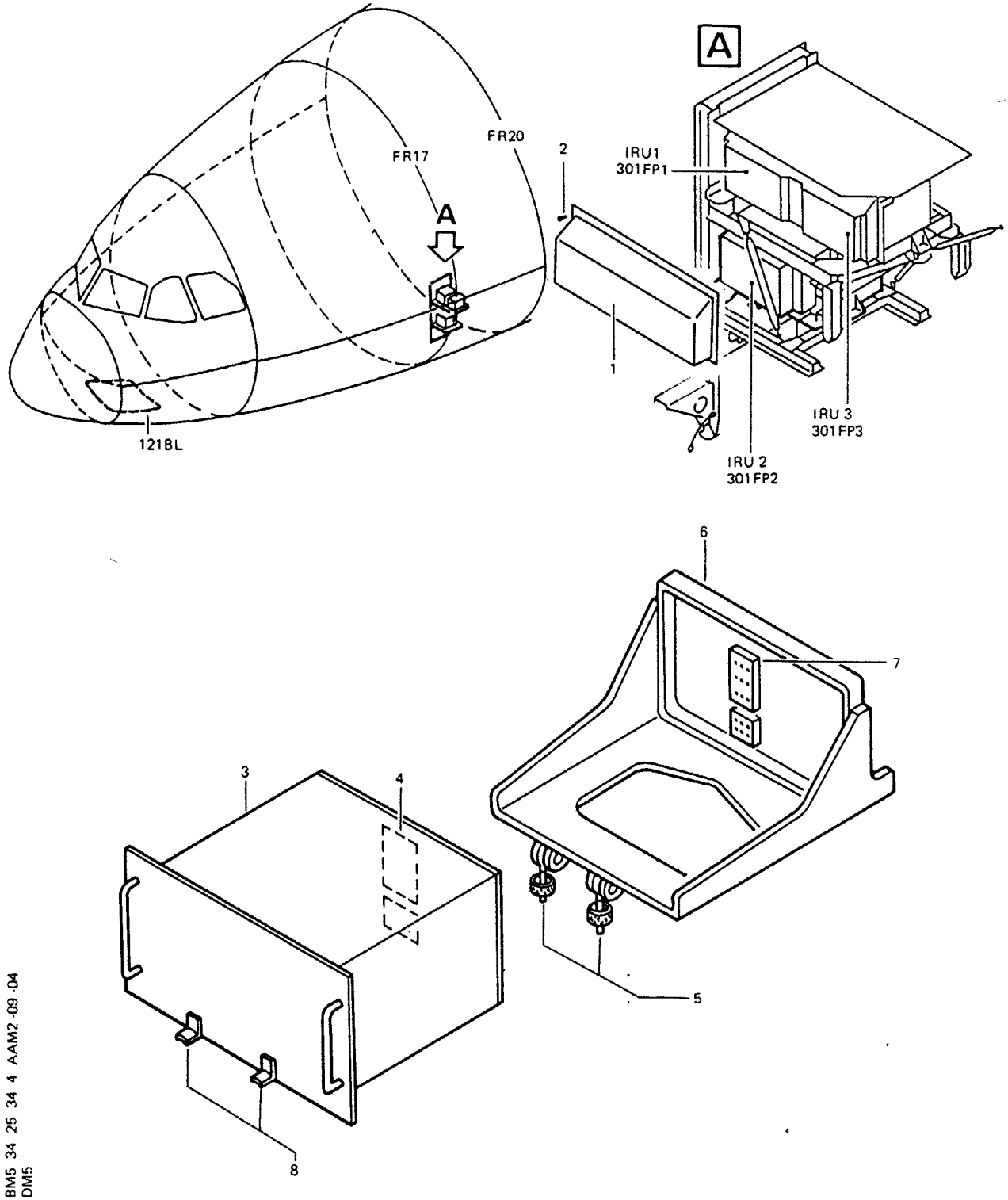
(4)Remove IRU (3).

C. Installation

(1)Clean and inspect IRU adjacent area.

(2)Remove blanking caps from electrical connectors (4) and (7).

(3)Check electrical connectors (4) and (7) for correct condition.



Inertial Reference Unit - Removal/Installation
Figure 401

(4)Slide IRU (3) into position in mount (6), making certain that the electrical connectors are correctly aligned with electrical connectors in mount.
(5)Engage knurled retaining nuts (5) in studs (8) and tighten.
(6)Remove safety clips and tags, and close the following circuit breakers according to the removed IRU (IRU 1 : 312FP1, 313FP1 ; IRU 2 : 312FP2, 313FP2 ; IRU 3 : 312FP3, 313FP3).

D. Test
Carry out the BITE test of (corresponding) IRS (Ref. 34-25-00, P. Block 501) (IRS operational test).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Install protective cover (1) on IRU1 and IRU3 and tighten the twelve Dzus fasteners (2).
(3)Close access door 121BL.

INERTIAL REFERENCE UNIT MOUNT - ADJUSTMENT/TEST

CAUTION : DO NOT DO THIS PROCEDURE UNLESS THE MOUNT/SHELF ASSEMBLY HAS BEEN MOVED.
THIS PROCEDURE REQUIRES VERY PRECISE ADJUSTMENT.
IT IS NOT REQUIRED DURING STANDARD REMOVAL/INSTALLATION OF IRU(S).

1. Reason for the Job

Alignment and adjustment of the unit mounts after removal/installation or change in position of the mount/shelf assembly.

2. Equipment and Materials

ITEM	DESIGNATION
A.	Clinometer
B.	Alignment Rig
R C. 98A34203000105	Harmonization Support
D. Material No.19-018	Lockwire (0.6 mm)
Referenced Procedures	
- 34-25-34, P. Block 401	Inertial Reference Unit - Removal/Installation
- 08-20-00, P. Block 401	Leveling
- 53-10-53, P. Block 401	Avionics Compartment - Fixed Partition - Removal/Installation
- 25-54-10, P. Block 201	FWD Cargo Compartment Linings - Maintenance Practices

3. Procedure

A. Job Set-Up
(1)Level aircraft (Ref. 08-20-00, P. Block 401).
(2)Remove the three Inertial Reference Units (Ref. 34-25-34, P. Block 401).
(3)Remove fixed partition against rack of Inertial Reference Units at FR20 (STA 1446) in LH FWD cargo compartment (Ref. 53-10-53, P. Block 401).
(4)Remove sidewalls located between FR20 (STA 1446) and FR22 (STA 1552) (Ref. 25-54-10, P. Block 201).

B. Heading Alignment of Upper and Lower IRU Mounts
(Ref. Fig. 501)
(1)Upper mounts
(a)Place terminal strip (1) on upper IRU mounts.
(b)Remove lockwire of each attachment point located under the mounts.
(c)Loosen each self-locking nut (4) of IRU mount attachment points.
(d)Place alignment rig in horizontal position and fix it against struts located on FR21 and FR22. The alignment rig must be set against terminal strip (1) (Ref. Fig. 502).
(e)Adjust the four eccentrics (5) to align terminal strip (1) with alignment rig.
(2)Lower mount
Carry-out same procedure as described above, with terminal strip (3).

C. Flatness Alignment of Upper IRU Mounts
(Ref. Fig. 501)

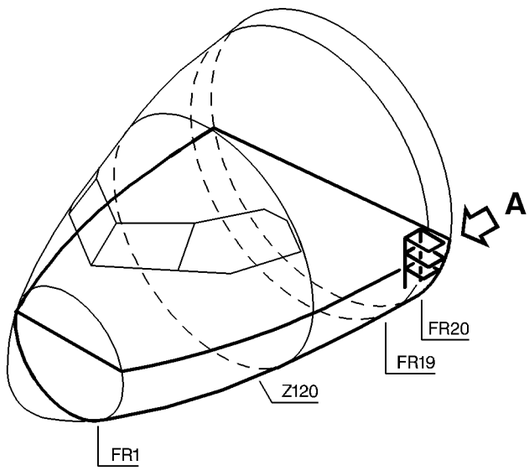
R (1)Install harmonization support 98A34203000105 in place of IRU1 301FP1
R on mount located on upper shelf of rack.
(2)Adjust nuts of attachment points to level IRU1 mount with clinometer according to different axis ranges.
(3)Check with clinometer that level of IRU2 mount is correct.
(4)Lock each self-locking nut (4).
(5)Safety each attachment point with lockwire (0.6 mm).

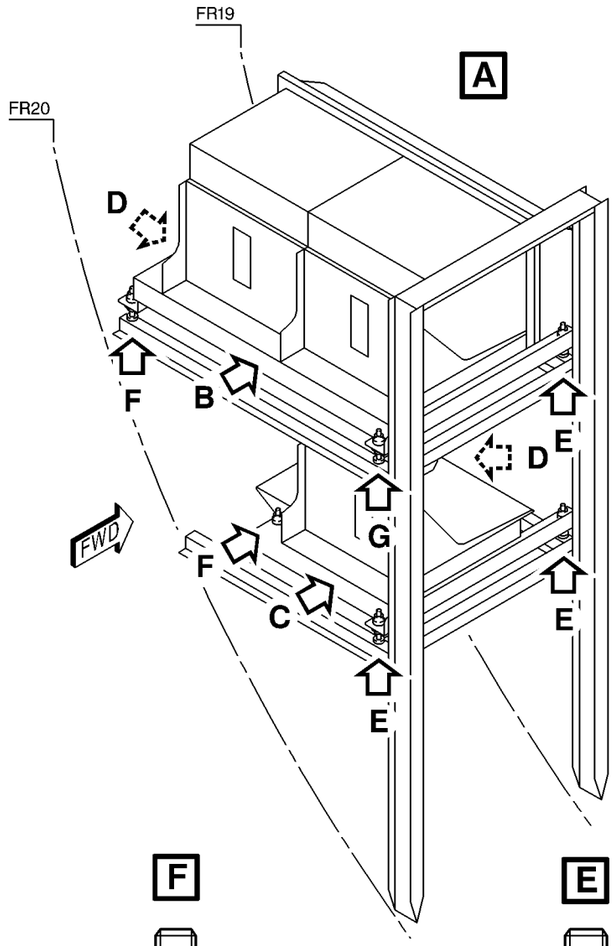
D. Flatness Alignment of Lower IRU Mount

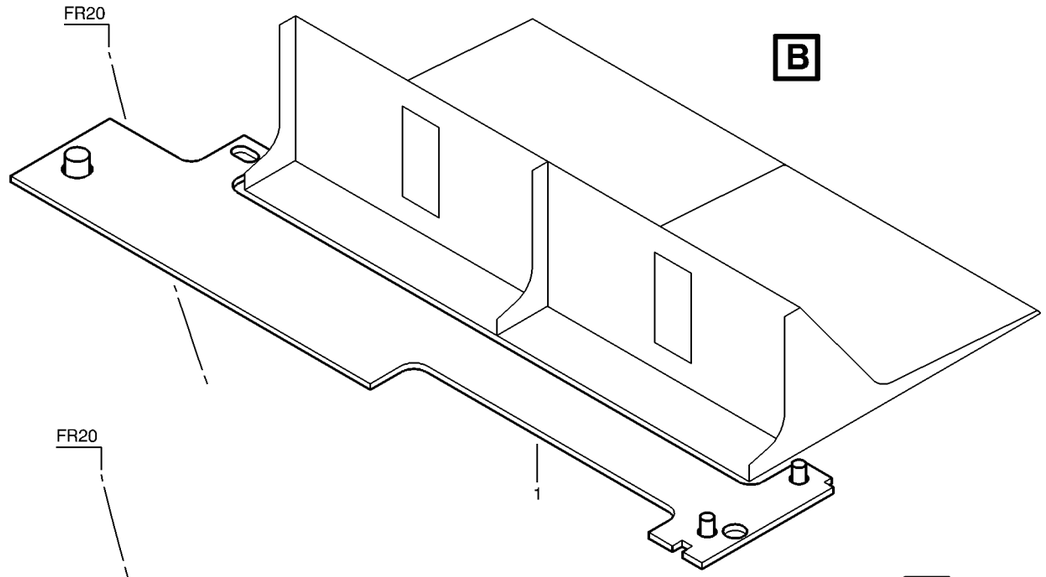
R (1)Install harmonization support 98A34203000105 in place of IRU3 301FP3
R on mont located on lower shelf of rack.
(2)Adjust nuts of attachment points to level IRU3 mount with clinometer according to different axis ranges.
(3)Lock each self-locking nut (4).
(4)Safety each attachment point with lockwire (0.6 mm).

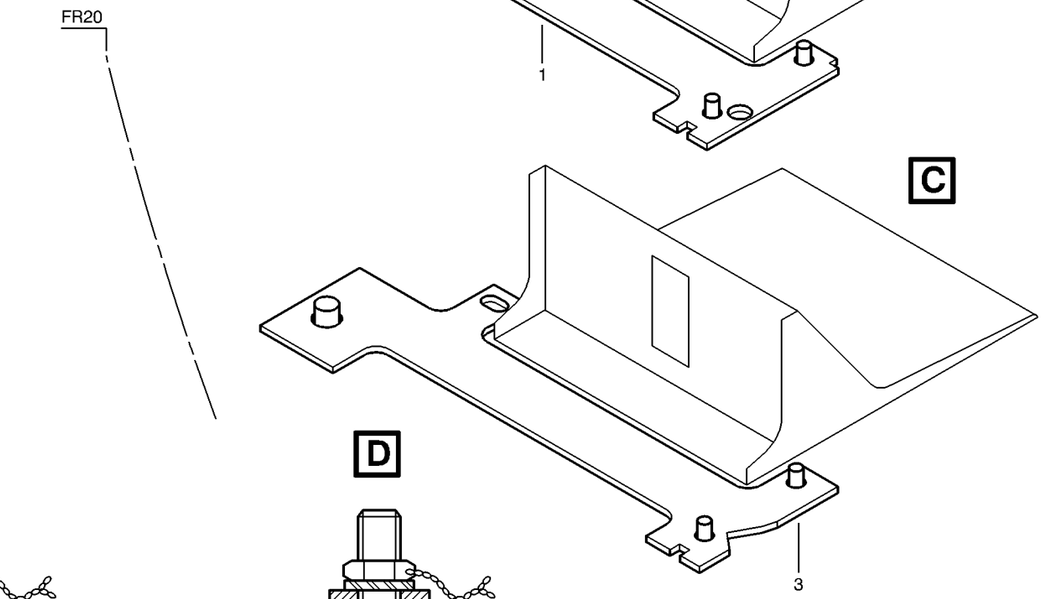
E. Close-Up

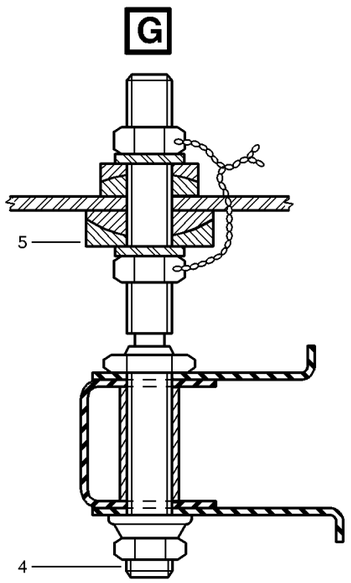
(1)Remove all ground handling and maintenance equipment, standard and special tools, together with ground power equipment, all access equipment and miscellaneous items.
(2)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(3)Install fixed partition against rack of Inertial Reference Units at FR20 (STA 1446) in LH FWD cargo compartment (Ref. 53-10-53, P. Block 401).
(4)Install sidewalls located between FR20 (STA 1446) and FR22 (STA 1552) (Ref. 25-54-10, P. Block 201).
(5)Install the three Inertial Reference Units (Ref. 34-25-34, P. Block 401).

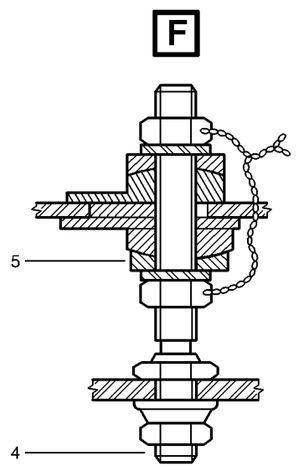


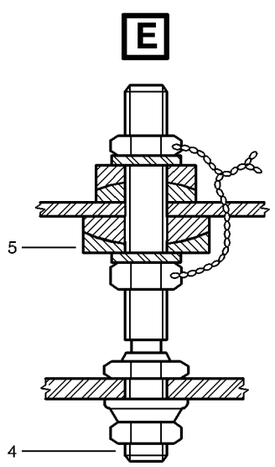


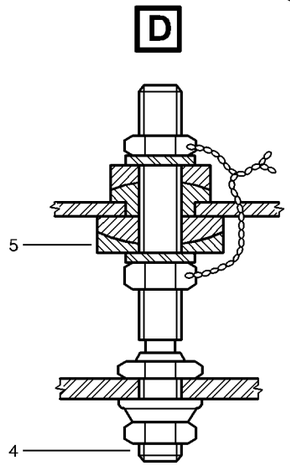


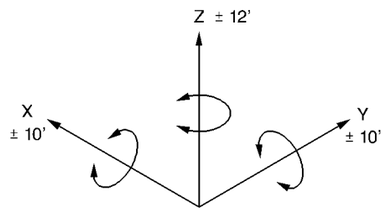












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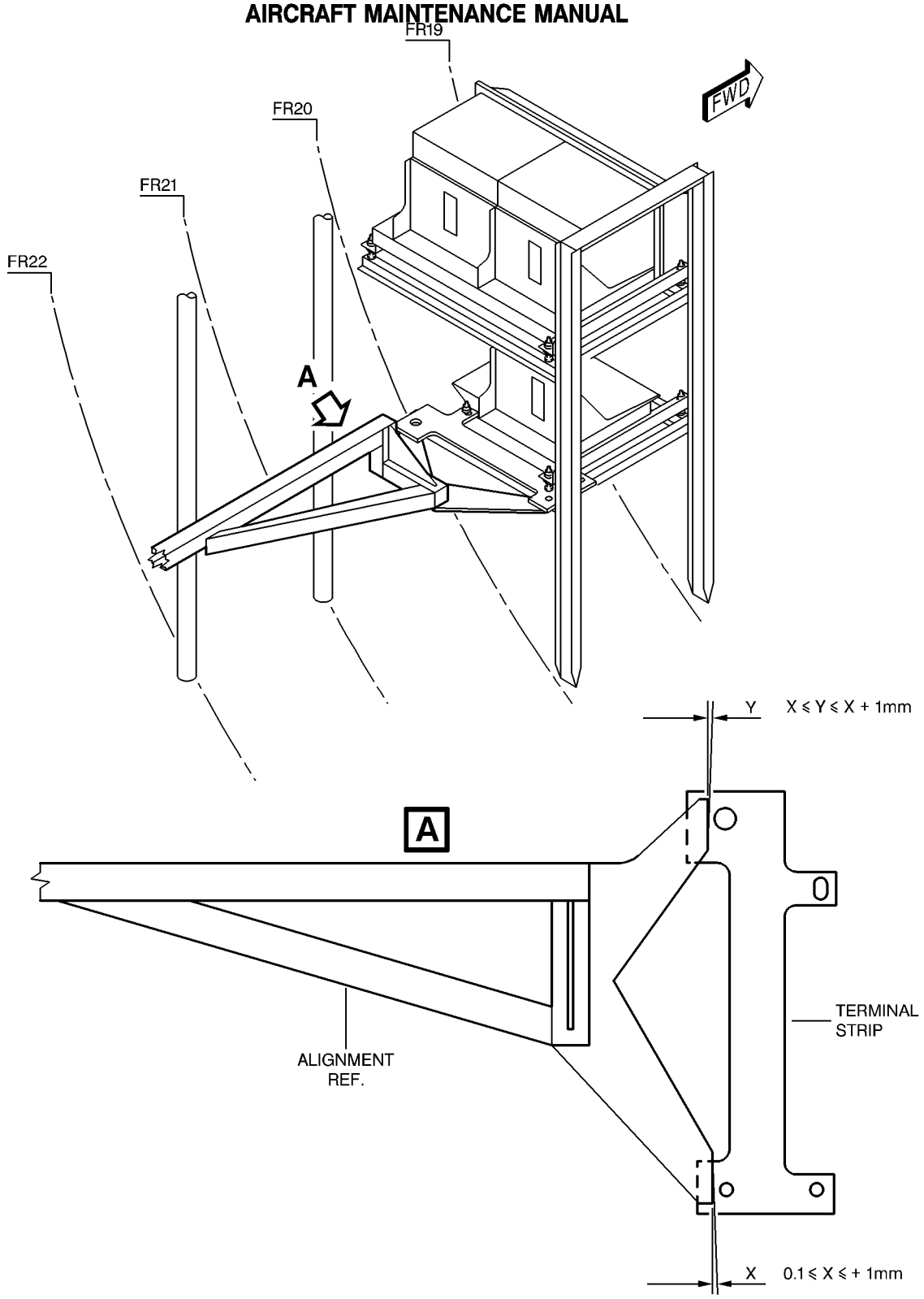
Inertial Reference Unit Mount - Alignment
Figure 501



Inertial Reference Unit Mount - Alignment Rig Installation
Figure 502

1. Operational Test

A. Reason for the Job
(1)To check standby horizon indicator.
NOTE : Attitude switching and indicating are checked in 34-25-00, P. Block 501).

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

C. Procedure
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.
(1)Job set-up
- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breaker (22VU) NAVIGATION/STBY/HORIZON 27FN1 line 204/F17.
- Make certain that the warning flag is in view on standby horizon indicator 25FN1.

(2)Test

ACTION	RESULT
1. On panel 22VU - close circuit breaker 27FN1	On standby horizon indicator 25FN1 - warning flag goes out of view
2. On standby horizon indicator 25FN1 - pull the fast erection knob and wait for a few seconds.	- the spherical display drun moves by rotation around the roll and pitch axes and stabilizes when the vertical position of gyroscope is reached.
NOTE : This maneuver must be carried out smoothly. - release the pulled knob.	- the horizon drum line is stabilized to its normal position and flush with aircraft symbol. - the roll index reads zero.

(3)Close-up
(a)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(b)Restore system and aircraft to normal operating condition.

2. Functional Test
   Identical to operational test

3. System Test
   Identical to operational test

STANDBY HORIZON INDICATOR (25FN1) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-27-00, P. Block 501	Attitude Information - Switching & Indicating

(Ref. Fig. 401)

2. Procedure

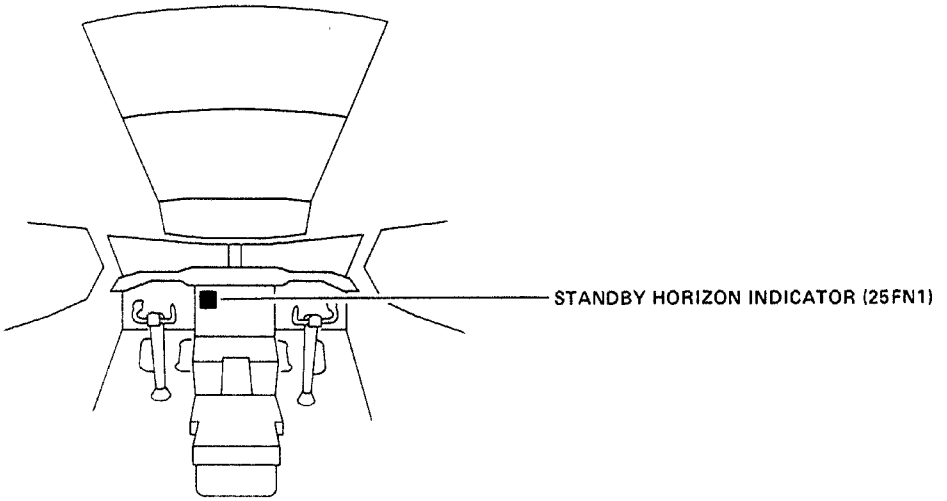
A. Job Set-Up

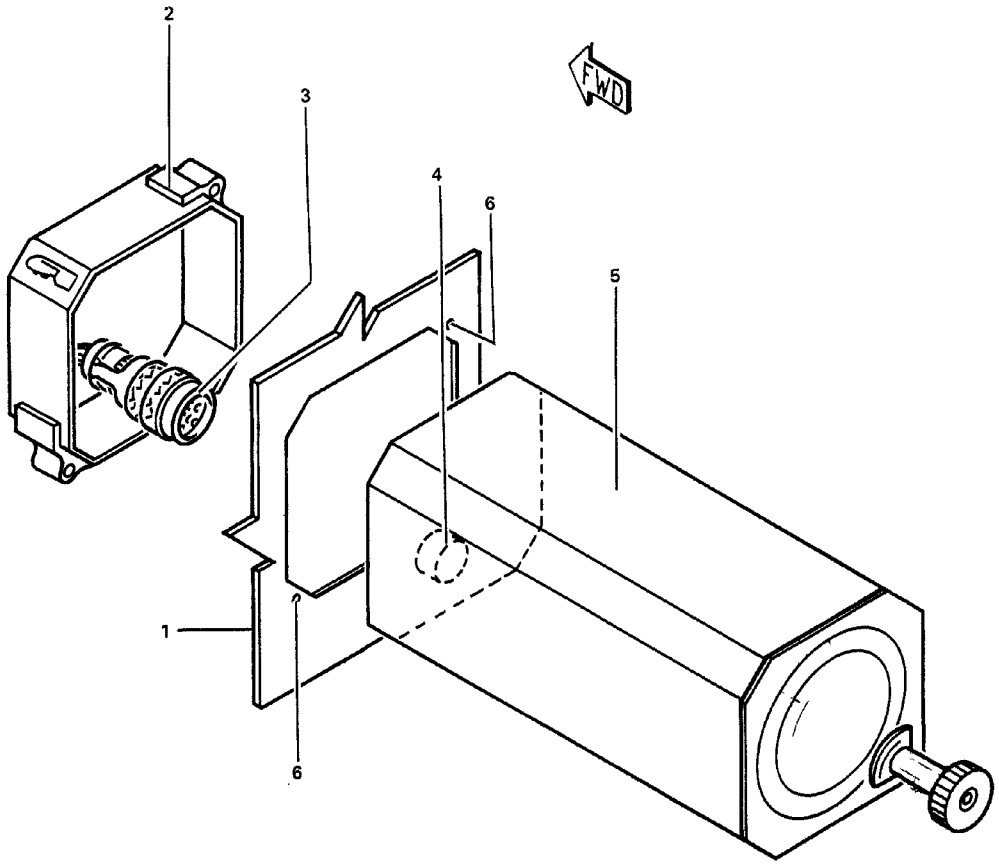
(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
22VU	NAVIGATION/STBY HORIZON	27FN1	204/F17
132VU	LIGHTING/INTEGRAL LT/MAIN PNL & GLARE SHLD	1LF	322/N76

CAUTION : WHEN THE INSTRUMENT IS TO BE TRANSPORTED EVEN OVER A SHORT DISTANCE, IT IS NECESSARY TO BLOCK THE GYROSCOPE ASSEMBLY BY MEANS OF THE LOCKING WEDGE PROVIDED.

(2)Make certain that standby attitude reference indicator is fully stopped.





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Standby Horizon Indicator
Figure 401

B. Removal
(1)Release the two screws (6) on clamp (2): do not remove screws.
(2)Pull out standby horizon indicator (5).
(3)Disconnect electrical connector (3).
(4)Cap electrical connector (3) and receptacle (4).
(5)Remove standby horizon indicator (5).

C. Installation
(1)Clean and inspect standby horizon indicator interface and/or adjacent area.
(2)Remove caps from electrical connector (3) and receptacle (4) and visually inspect pins.
(3)Position standby horizon indicator (5).
(4)Connect electrical connector (3).
(5)Position standby horizon indicator (5) in panel (1).
(6)Install and tighten screws (6).
(7)Remove safety clips and tags and close the following circuit breakers : 27FN1 et 1LF.

D. Test
(1)Carry out an operational test of standby horizon indicator (Ref. 34-27-00, P. Block 501).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

1. Compensation Adjustment

NOTE : Heading switching and indicating are checked in 34-25-00, P. Block 501)

A. Reason for the Job

(1)To carry out a compensation adjustment of standby compass and to determine compass deviation curve when reading discrepancy with respect to magnetic heading from IRS and displayed on NDs exceeds ±10°.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Tractor
R (2)CE2-40	Compensation Key
(3)	Non-Magnetic Tools
(4)	Standby Compass Deviation Curve
Referenced Procedure - 49-40-00, P. Block 301	APU Starting-Up

NOTE : To position the aircraft to the various magnetic headings (MH) as required in this test one of the following references must be used depending on the local material conditions :
- magnetic heading (MH) readings on inertial reference system indicators.
- true heading reference marks on the compensation base, corrected for local magnetic variation (VAR).
- readings using a theodolite (to be added to the equipment list above when the other two methods cannot be used).

MH = TH + VAR (for westerly variations, e.g. Europe, USA east coast)
MH = TH - VAR (for easterly variations, e.g. Japan, USA west coast).

C. Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(1)Job set-up

(a)Place the aircraft on a compensation base with no metal objects in the vicinity.

NOTE : Compensation base is a level area :
- sufficiently large for aircraft to turn smoothly 360 degrees
- with no metal objects near it (vehicles, other aircraft not less than 250 ft from aircraft, building with magnetic materials not less than 600 ft from aircraft).

(b)Start APU and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(c)Make certain that the forward services ventilation system is in operation (Ref. 21-20-00, P. Block 301).

(d)Make certain that all the systems are operating, (particularly : HF; VHF; IRS; ADF; VOR)

(e)On panel 436VU

Place STBY COMPASS/OFF switch 208LF in STBY COMPASS position.

(f)On windshield center post

- make certain that standby compass lighting is on
- check support and secure attachment of standby compass and make certain that there are no traces of leaks.
- examine liquid in bowl of standby compass and make certain that it is clear and that it contains neither bubbles nor sediments.

(2)Adjustment

(Ref. Fig. 501)

(a)Compensation adjustment of standby compass

R NOTE : The compensation key is located inside the spare bulb box
R (zone 210).

1 On standby compass

- place at zero compensation system linked to E-W axis, by means of compensation key inserted in correction hole B on upper left of compass to cancel LH pointer indication on indicator located on upper part of mounting plate.
- place at zero compensation system linked to N-S axis by means of compensation key inserted in compensation hole C on upper right of compass to cancel RH pointer indication on indicator located on upper part of mounting plate.

2 On compass support

- loosen the two securing screws so as to allow the compass bowl to move in relation to its support.
- turn compass bowl in order to read 0 value on scale (A) on upper part of compass.

3 Position aircraft to north (MHN) according to system selected (see NOTE above).

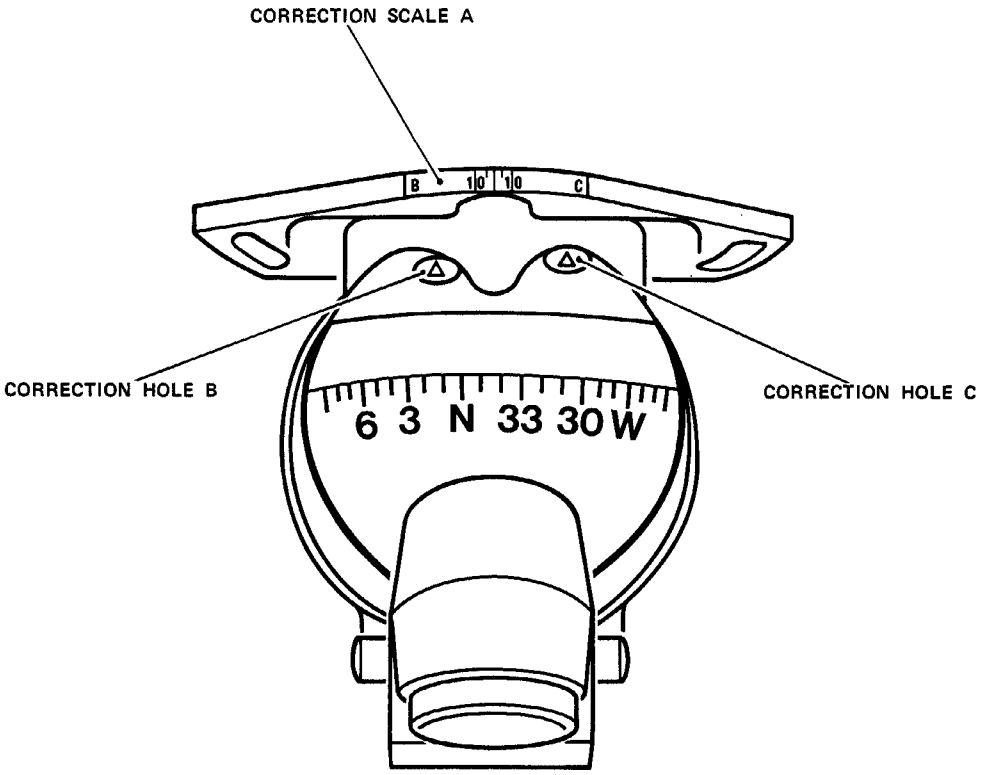
- calculate and record magnetic deviation ΔN :
  ΔN = MHN - CH
  (CH = compass heading indication on standby compass)

4 Position aircraft to east (MHE)

- calculate and record ΔE :
  ΔE = MHE - CH

5 Position aircraft to south (MHS)

- calculate and record ΔS :
  ΔS = MHS - CH
- calculate N-S single cycle error coefficient C
  $C = \frac{\Delta N - \Delta S}{2}$
- calculate the compensated compass heading CH comp(c) starting from the actual compass heading CH which is indicated on the standby compass :
  $CH_{comp(c)} = CH - C$
- adjust the N-S compensation system by means of the compensation key inserted into correction hole "C" to produce CH comp(c) reading on standby compass.



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R

Standby Compass
Figure 501

6 Position aircraft to west (MHW)
- calculate and record ΔW :
  ΔW = MHW - CH
- calculate E-W single cycle error coefficient B
  $B = \frac{\Delta E - \Delta W}{2}$
- calculate the compensated compass heading CH comp(b) starting from the actual compass heading CH which is indicated on the standby compass :
  $CH_{comp\ (b)} = CH - B$
- adjust the E-W compensation system by means of the compensation key inserted into correction hole "B" to produce CH comp(b) reading on standby compass.
- calculate index error coefficient A :
  $A = \frac{\Delta N + \Delta S + \Delta E + \Delta W}{4}$
  A must be less than or equal to 2 degrees.
  If A exceeds 2 degrees, turn the compass bowl on its support to produce on standby compass CH comp(a) reading such that
  $CH_{comp(a)} = CH_{comp(b)} + A$
- tighten the compass attachment screws without changing position of compass with respect to its support.

(b)Determination of deviation curve

NOTE : During adjustment, the standby compass performs a 360° rotation, which allows to check that letters and graduations on compass card are not damaged.

- position aircraft successively to the twelve headings required for determination of deviation curve :
  0°, 30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°, 330°,
  and note the value displayed on standby compass and that displayed on NDs for each aircraft position.
- calculate residual deviations R (...degrees) such that :
  R (... degrees) = MH - standby compass reading.
- check that
  . residual deviations R (...degrees) do not exceed ±10 degrees for each heading.
  . the maximum spread between positive and negative deviations R (...degrees) does not exceed 10°
  . the difference between standby compass and ND heading values for each heading is less than or equal to ±10°. Otherwise, perform a new compensation adjustment.
- enter the residual deviation values on correction card and place card on its support above standby compass.

(3)Close-up

(a)Switch off all systems started up for the test.

(b)De-energize the aircraft electrical network and shut down APU.

(c)Remove all ground handling and maintenance equipment, standard and special tools, together with ground power and replenishing equipment, all access equipment and miscellaneous items.

2. Operational Test

A. Reasons for the Job
(1)To ensure that difference between standby compass and ND heading values is less than or equal to ± 10°.
(2)To ensure that standby compass lighting operates correctly.
(3)To ensure that the compass card is clearly visible.

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-25-00, P. Block 501	Inertial Reference System

C. Procedure
(1)Job set-up
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.
(a)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Perform IRS 1 alignment as per 34-25-00, P. Block 501.
(2)Test

ACTION	RESULT
1. Read heading value displayed on ND	Check that discrepancy between standby compass and ND heading values is less than or equal to ± 10°.
On overhead panel - place MSU1 mode selector switch in OFF position	
2. On panel 436VU - place STBY COMPASS/OFF switch 208LF in STBY COMPASS position	On windshield center post - standby compass lighting is on - compass card can be read from Captain and First Officer seats.
- place STBY COMPASS/OFF switch 208LF in OFF position.	- standby compass lighting goes off.

(3)Close-up
(a)De-energize aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Restore system and aircraft to normal operating condition.

3. Functional Test

Identical to operational test.

4. System Test
Identical to operational test.

R 5. Demagnetizing Procedure
R Perform the demagnetization of the standby compass area (Ref. 05-54-00,
R P. Block 001).

R 1. Removal/Installation of Standby Compass

A. Equipment and Materials

ITEM	DESIGNATION
A.	Non Magnetic Tools
B.	Circuit Breaker Safety Clips
C.	Blanking Plugs/Caps
Referenced Procedure - 34-28-00, P. Block 501	Heading Information - Switching and Indicating

(Ref. Fig. 401)

B. Procedure

(1)Job Set-Up

(a)Open, safety and tag the following circuit breaker :

PANEL	SERVICE	IDENT.	LOCATION
132VU	LIGHTING/EMER LT/STBY COMPASS	18LF	324/L74

(2)Removal

1 Pull retractable support (2) out of housing (1).
2 Disconnect connector (4) from standby compass (3).
3 Unscrew and remove two screws (5) two washers (6) and two nuts (7).
4 Remove standby compass (3).
5 Blank connector (4) and standby compass (3) connector.

(3)Installation

1 Clean and inspect standby compass interface and/or adjacent area.
2 Remove blanking caps from connector (4) and standby compass (3) connector.
3 Place and hold standby compass (3) in its retractable support (2).
4 Attach standby compass (3) with two screws (5) two washers (6) and two nuts (7).
5 Connect connector (4) to standby compass.
6 Remove safety clip and tag and close circuit breaker 18LF.

(4)Test

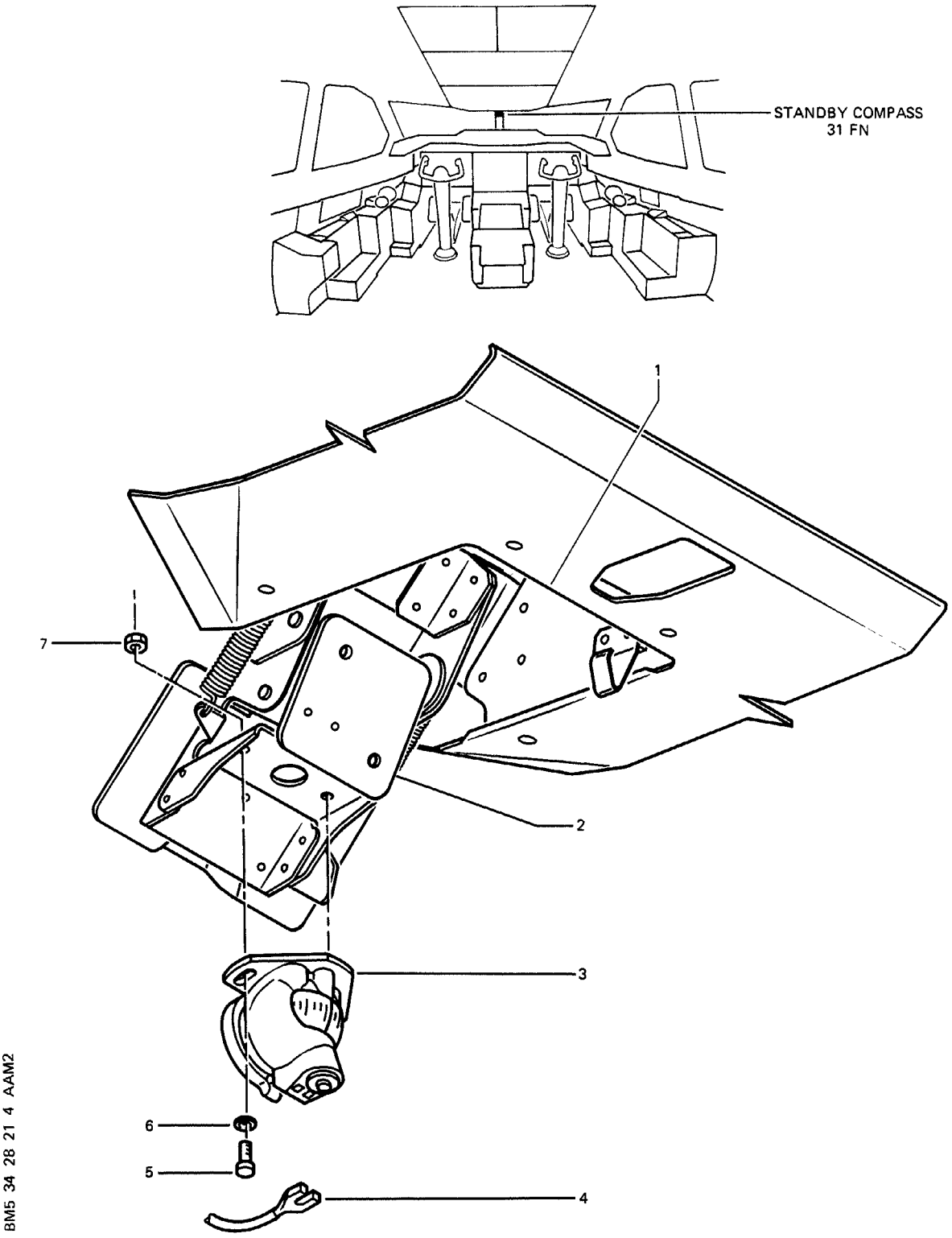
Carry out standby compass compensation adjustment and operational test. (Ref. 34-28-00, P. Block 501).

(5)Close-Up

1 Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
2 Place standby compass retractable support (2) in its housing (1).

2. Removal/Installation of Standby Compass Lamp

A. Equipment and Materials



Standby Compass
Figure 401

ITEM	DESIGNATION
(1)	Bulb 28 V 0.04 A Non Magnetic P/N ZV 3335

R (Ref. Fig. 402)

B. Procedure

(1)Job Set-up

(a)Open, safety and tag the following circuit breaker :

PANEL	SERVICE	IDENT.	LOCATION
132VU	LIGHTING/EMER LT/STBY COMPASS	18LF	903/L87

(2)Removal

1 Pull retractable support (2) out of housing (1).

R 2 Unscrew the cap (5).

R 3 Remove the bulb (4) from the lamp housing (3).

(3)Installation

R 1 Position the bulb (4) within the lamp housing (3).

R 2 Tighten the cap (5).

R 3 Remove safety clip and tag and close circuit breaker 18LF.

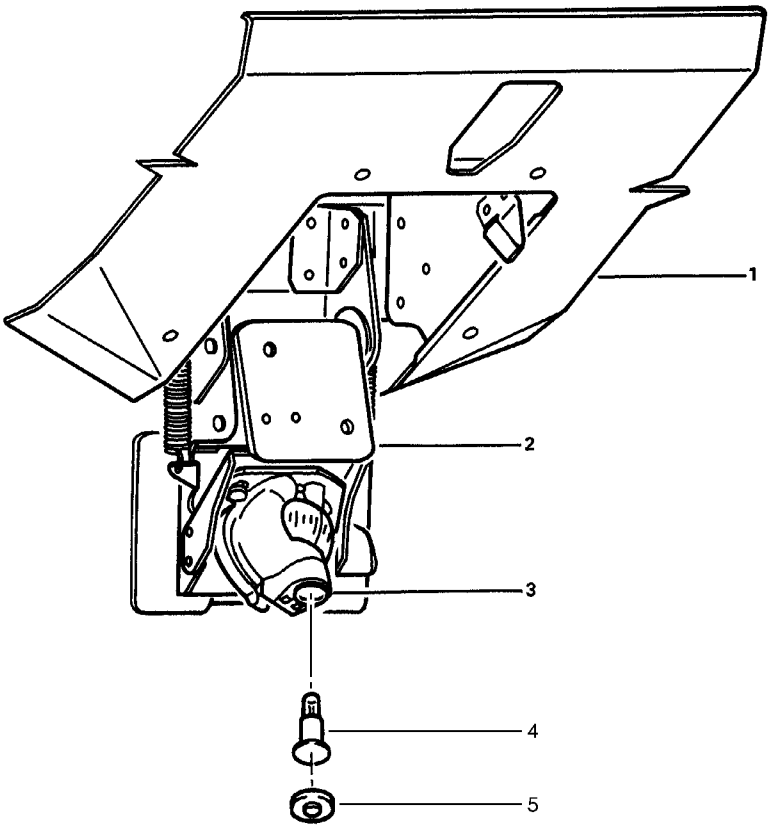
(4)Test

When control switch 208LF, on panel 436VU, is placed in STBY COMPASS position, make certain that standby compass lighting is on.

(5)Close-up

1 Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

R 2 Place retractable support (2) in its housing (1).



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R

Standby Compass - Lamp Disassembly
Figure 402

VOR/DME RMI (10FN1, 10FN2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Cap
Referenced Procedure - 34-25-00, P. Block 501 (Ref. Fig. 401)	Inertial Reference System

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For Captain VOR/DME RMI

PANEL	SERVICE	IDENT.	LOCATION
22VU	NAVIGATION CAPT/RMI VOR/DME	11FN1	204/F15
22VU	NAVIGATION/CAPT/INST/SW	5FN1	204/F16
132VU	LIGHTING/INTEGRAL LT/MAIN PNL & GLARE SHLD	1LF	322/N76

(b)For First Officer VOR/DME RMI

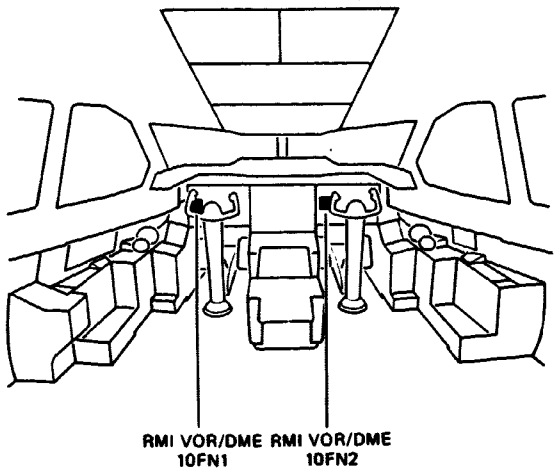
PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/F/O/RMI VOR/DME	11FN2	104/F10
21VU	NAVIGATION/F/O/INST/SW	5FN2	104/F 8
132VU	LIGHTING/INTEGRAL LT/MAIN PNL & GLARE SHLD	1LF	322/N76

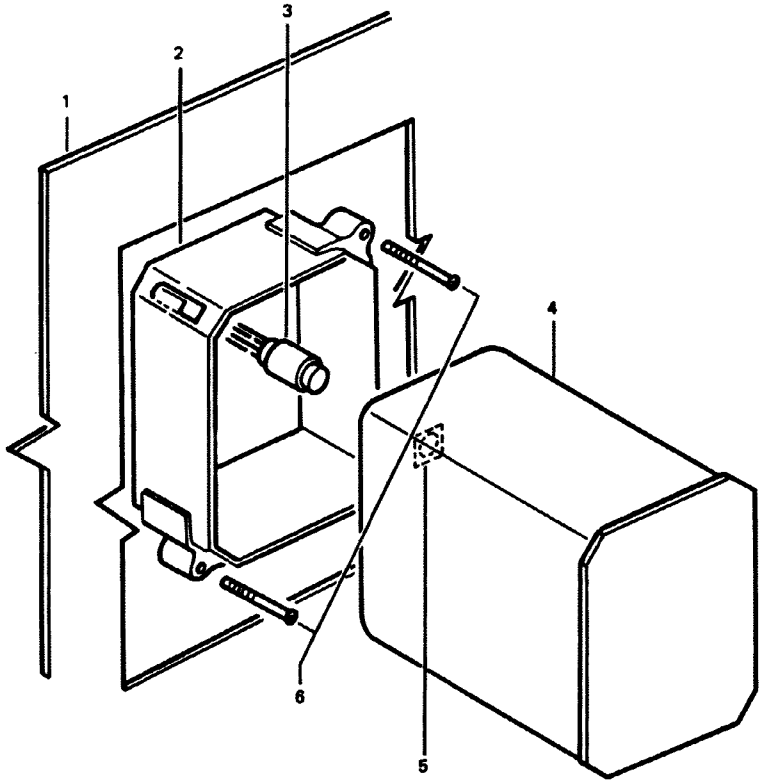
B. Removal

(1)Slacken the two screws (6) on clamp (2). Do not remove screws.
(2)Extract VOR/DME RMI (4) from housing.
(3)Disconnect and cap electrical connector (3).
(4)Blank receptacle (5) on VOR/DME RMI (4).
(5)Remove VOR/DME RMI (4).

C. Installation

(1)Clean and inspect installation area including clamp (2).
(2)Remove blanking cap from electrical connector (3) and receptacle (5).
(3)Connect electrical connector (3) to VOR/DME RMI (4).
(4)Install VOR/DME RMI (4) on main instrument panel (1).
(5)Tighten screws (6).
(6)Remove safety clips and tags and close the following circuit breakers :
(a)For Captain VOR/DME RMI : 11FN1, 5FN1 and 1LF.
(b)For First Officer VOR/DME RMI : 11FN2, 5FN2 and 1LF.





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VOR/DME RMI Removal/Installation
Figure 401

D. Test
Carry out BITE test of IRS1 and IRS2, Ref. 34-25-00, P. Block 501 (IRS operational test but read only heading value on VOR/DME RMI).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-25-00, P. Block 501 (Ref. Fig. 401)	Inertial Reference System

2. Procedure

A. Job Set-Up

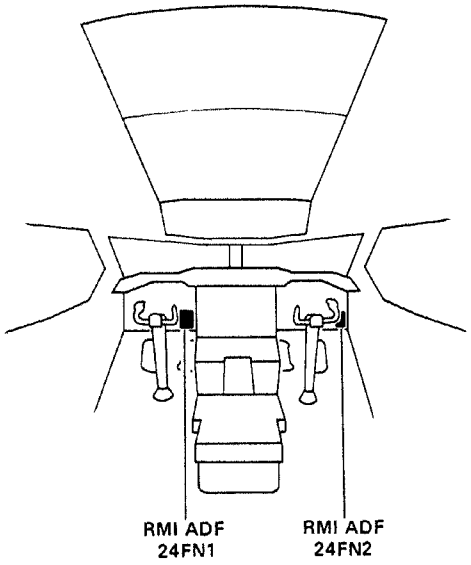
(1)Open, safety and tag the following circuit breakers :

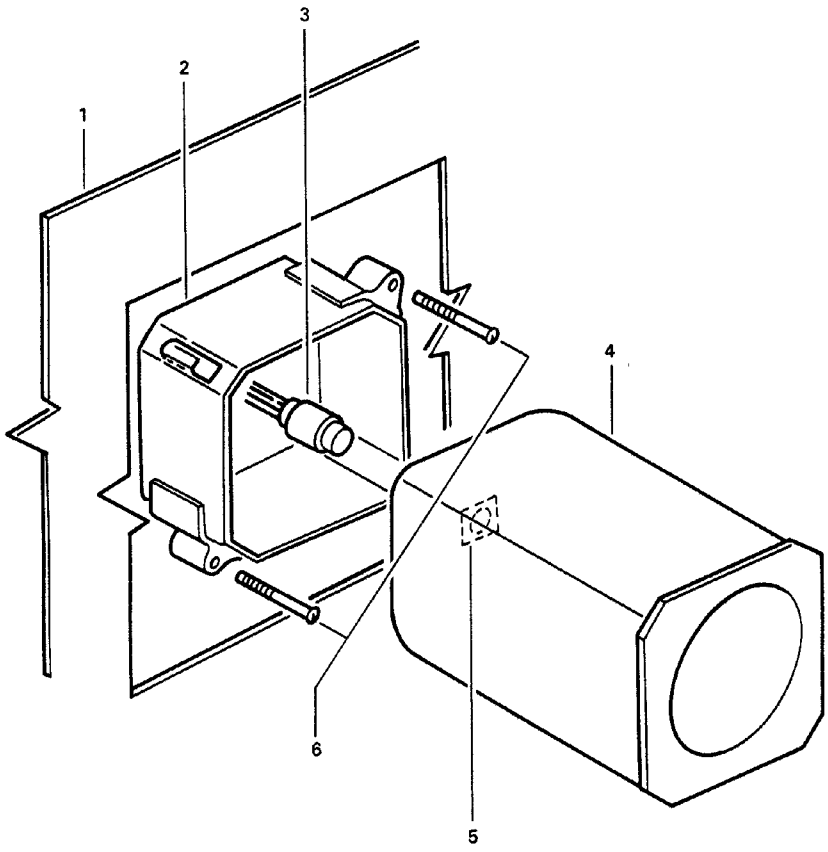
(a)For Captain ADF RMI :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/CAPT/RMI ADF	46FN1	104/F 5
21VU	NAVIGATION/F/O/INST/SW	5FN2	104/F 8
132VU	LIGHTING/INTEGRAL LT/MAIN PNL & GLARE SHLD	1LF	322/N76

(b)For First Officer ADF RMI :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/F/O/RMI ADF	46FN2	104/F 9
22VU	NAVIGATION/CAPT/INST/SW	5FN1	204/F16
132VU	LIGHTING/INTEGRAL LT/MAIN PNL & GLARE SHLD	1LF	322/N76





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ADF RMI - Removal/Installation
Figure 401

B. Removal
(1)Slacken the two screws (6) on clamp (2). Do not remove screws.
(2)Extract ADF RMI (4) from housing.
(3)Disconnect and cap electrical connector (3).
(4)Blank receptacle (5) on indicator (4).
(5)Remove indicator (4).

C. Installation
(1)Clean and inspect installation area including clamp.
(2)Remove blanking cap from electrical connector (3) and receptacle (5).
(3)Connect electrical connector (3) to indicator (4).
(4)Install indicator (4) on instrument panel (1) and tighten screws (6).
(5)Remove safety clips and tags and close the following circuit breakers:
(a)For Captain ADF RMI : 46FN1, 5FN2, 1LF.
(b)For First Officer ADF RMI : 46FN2, 5FN1, 1LF.

D. Test
Carry out IRS1 and IRS2 BITE test, Ref. 34-25-00, P. Block 501 (IRS operational test but read only heading value on ADF RMI).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

MARKER BEACON SYSTEM - DESCRIPTION AND OPERATION

1. General

The Marker Beacon System (MKR) is a radio navigation aid. It is normally used together with the Instrument Landing System (ILS) during an ILS approach to determine the distance between the aircraft and the runway threshold. It also marks particular airway and holding points. The system provides visual, aural and digital indications of the passage of the aircraft over beacon transmitters located on the ground.

2. Component Location

**ON A/C 001-100,

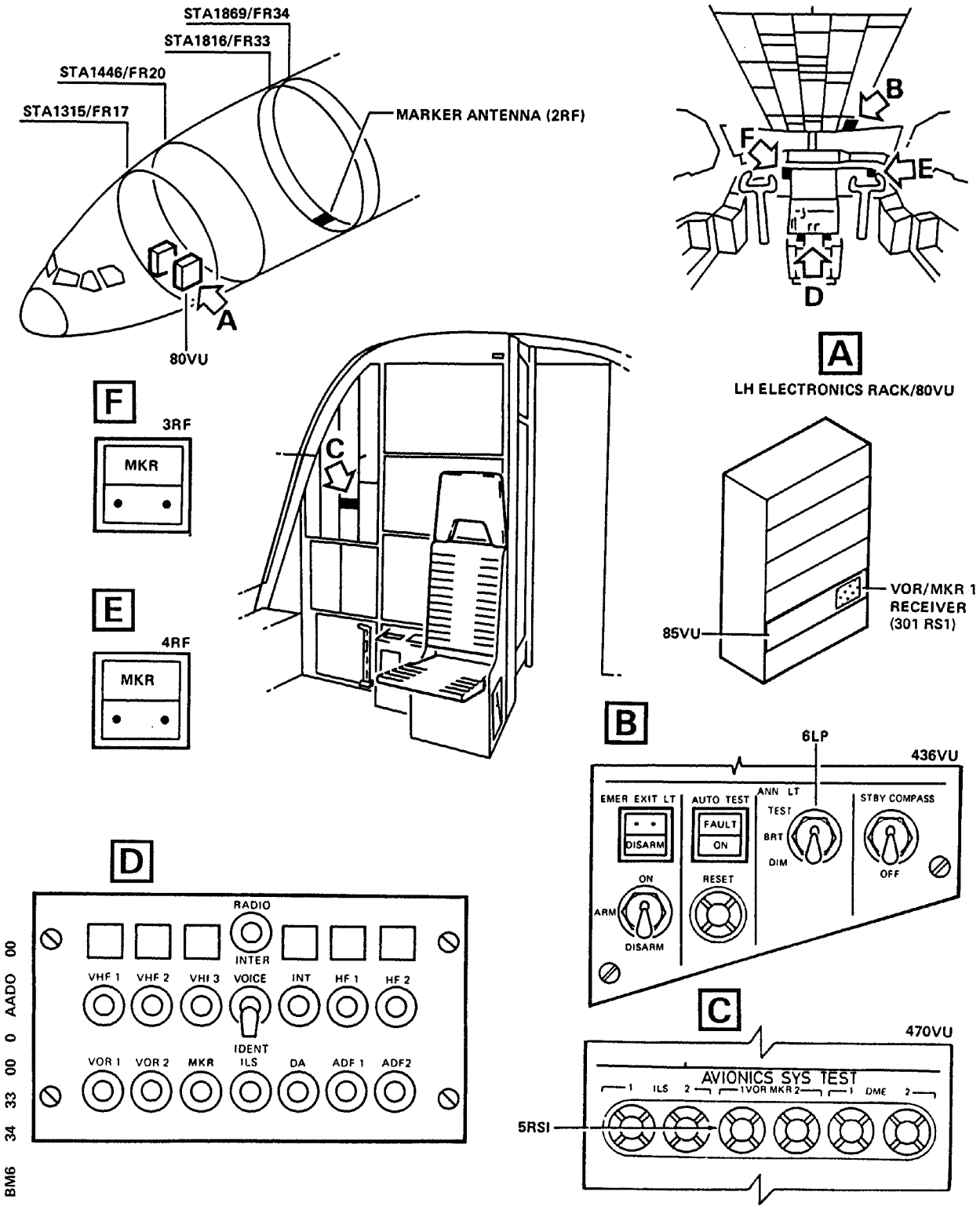
(Ref. Fig. 001)

**ON A/C 101-200,

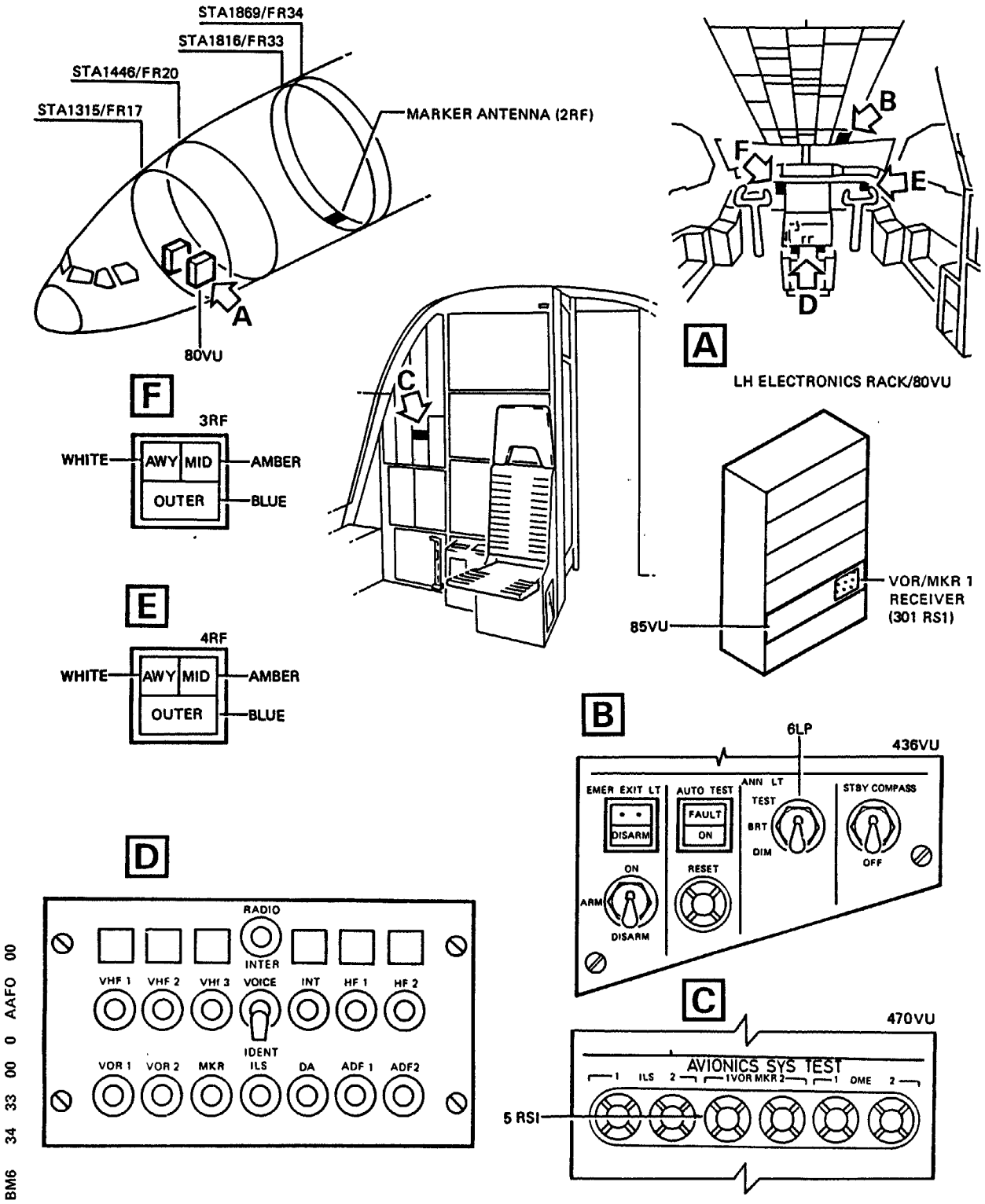
(Ref. Fig. 002)

**ON A/C ALL

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
	MKR SYSTEM :				
2RF	ANTENNA		130		34-33-13
3RF	ANNUNCIATOR LIGHT	3VU	211		
4RF	ANNUNCIATOR LIGHT	5VU	212		
	ASSOCIATED SYSTEM :				
301RS1	VOR/MKR 1 RECEIVER	85VU	121		34-55-31
5RS1	VOR/MKR 1 TEST BUTTON	470VU	212		
264LT	RELAY	490VU	212		
273LT	RELAY	490VU	212		
6LP	SWITCH	436VU			



Marker Beacon System - Component Location
Flight Crew Compartment
Figure 001



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Marker Beacon System - Component Location
Flight Crew Compartment
Figure 002

3. System Description

A. Principle (Ref. Fig. 003)

(1)Marker Beacon transmitters, known as markers, and positioned on the ground at known distances from the runway threshold, transmit a modulated 75 MHz signal to provide a marked position for the Captain and First Officer.
The receiver in the aircraft converts this signal into both an aural and visual indication.
The markers consist of:
- an outer marker, located at approx. 4 NM from the runway threshold and modulated with a 400 Hz signal, and is keyed to emit dashes for identification,
- a middle marker, located at approx. 0.6 NM from the runway threshold and modulated with a 1300 Hz signal, and is keyed to emit alternate dots and dashes for identification,
- an inner marker, utilized by some airfields only, and modulated with a 3000 Hz signal.
- an airways marker, located at particular airways and holding points, and also modulated with a 3000 Hz signal.

(2)As the aircraft crosses over a marker, the modulating frequency is detected and used to provide aural, visual and digital indications of the marker crossing.

**ON A/C 001-100,

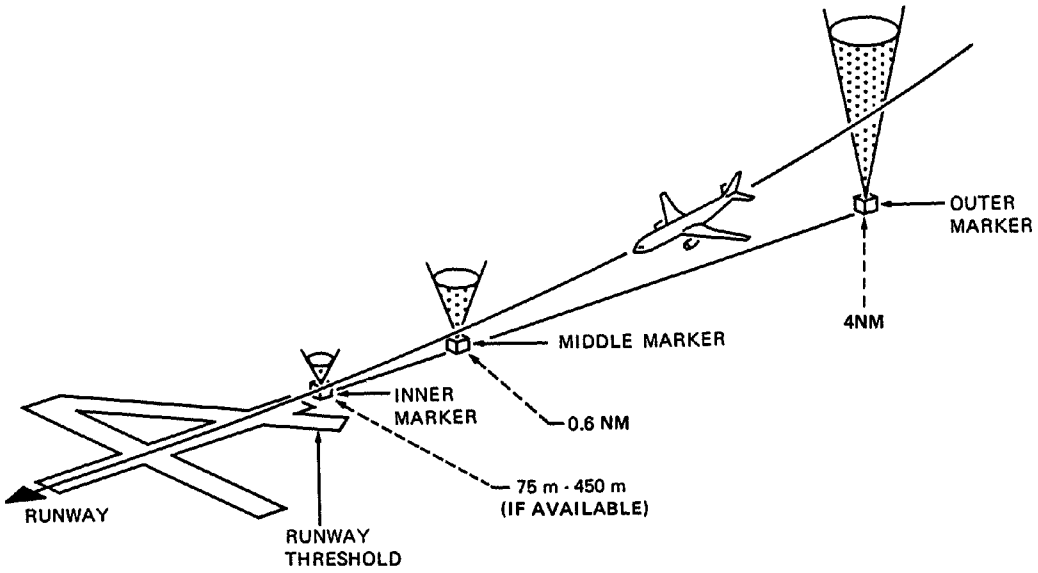
B. System Architecture

The A/C is equipped with only one MKR system. The MKR receiver is part of the VOR/MKR receiver 1.
The MKR part is connected to:
- a separate MKR antenna,
- the annunciator lamps (one each for Captain and F/O),
- the audio integrating system,
- the AVIONICS SYS TEST panel and
- the AIDS.

The three discrete lamp outputs (Outer, Middle, Airways) are connected to obtain one common output illuminating the two blue annunciators.
The audio output supplies the audio interphone system with the related MKR signals:
- 400 Hz for Outer MKR
- 1300 Hz for Middle MKR
- 3000 Hz for Airways MKR.

The test circuit activates both VOR and MKR BITE to produce common outputs which are for MKR:
- annunciator lamp indication,
- digital data for AIDS.

Electrical A/C power is supplied for both VOR and MKR receivers via circuit breaker 6RS1. The annunciator lamps are supplied by the lighting system with 28 V DC.



BM6 34 33 00 0 ACAO 00

Marker Beacon System - System Principle
Figure 003

**ON A/C 101-200,

B. System Architecture
The A/C is equipped with only one MKR system. The MKR receiver is part of the VOR/MKR receiver 1.
The MKR part is connected to:
- a separate MKR antenna,
- the annunciator lamps (three indicator lights, white amber and blue) for Captain and F/O, one set each,
- the audio integrating system,
- the AVIONICS SYS TEST panel and
- the AIDS.

The three discrete lamp outputs (Outer, Middle and Airways) are connected to illuminate the corresponding annunciator lamps.
- the Outer output to the two blue OUTER annunciator lamps,
- the Middle output to the two amber MID annunciator lamps,
- the Airway output to the two white AWY annunciator lamps.

The audio output supplies the audio interphone system with the related MKR signals:
- 400 Hz for Outer MKR
- 1300 Hz for Middle MKR
- 3000 Hz for Airways MKR.

The test circuit activates both VOR and MKR BITE to produce common outputs which are for MKR:
- annunciator lamp indication and audio tone is heard.
- digital data for AIDS.

Electrical A/C power is supplied for both VOR and MKR receivers via circuit breaker 6RS1. The annunciator lamps are supplied by the lighting system with 28 V DC.

**ON A/C 001-100,

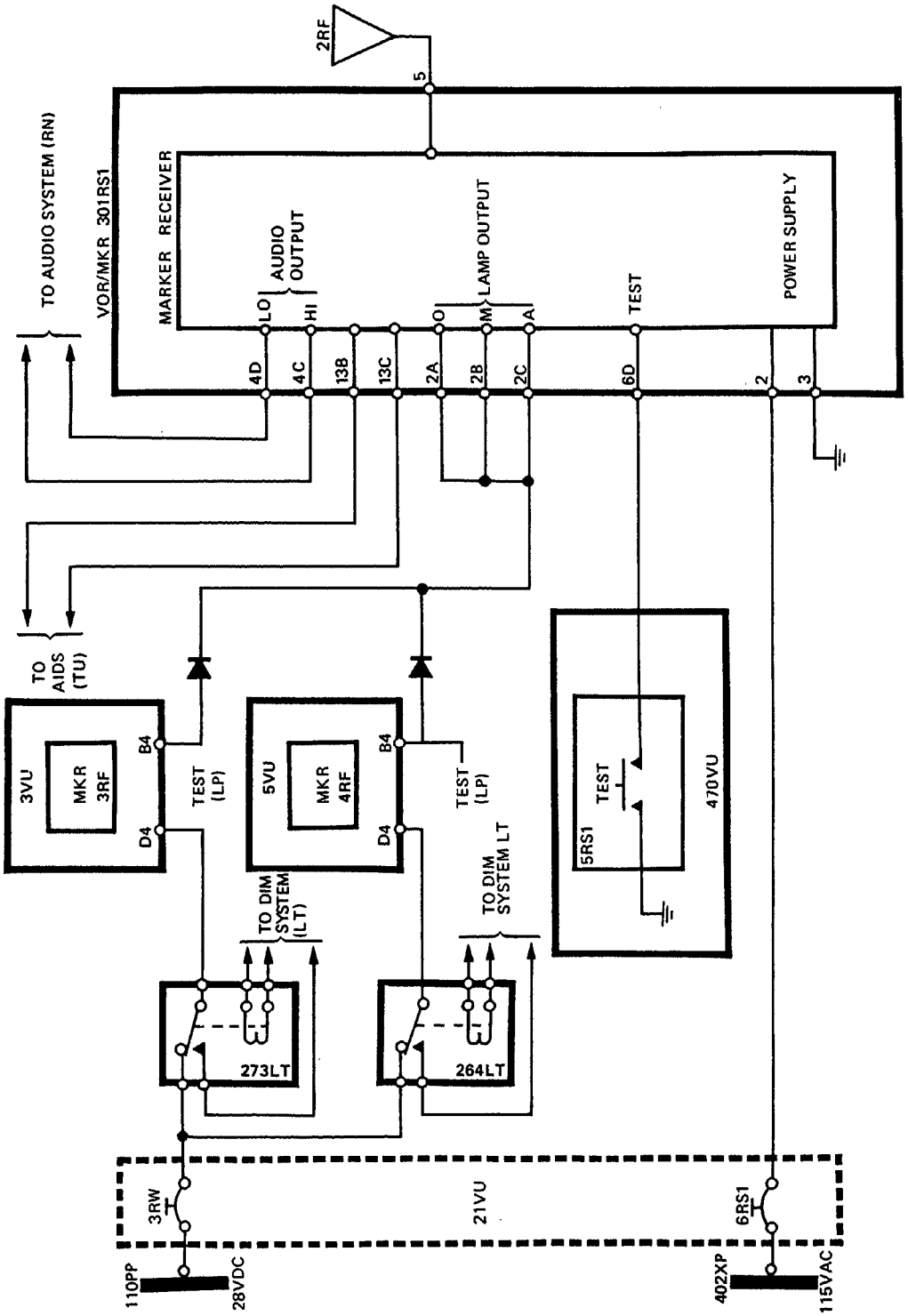
(Ref. Fig. 004)

**ON A/C 101-200,

(Ref. Fig. 005)

**ON A/C ALL

C. Power Supply
The VOR/MKR1 receiver is supplied with 115 V, 400 Hz from the emergency busbar 402XP via circuit breaker 6RS1.
The MKR annunciators are supplied with a voltage of up to 28 V DC depending on the dim mode:
- switch 6LP in TEST position from DC Bus 110PP via circuit breaker 3RW,
- switch 6LP in BRIGHT/DIM position from DC BUS 110PP via circuit breaker 197LT.



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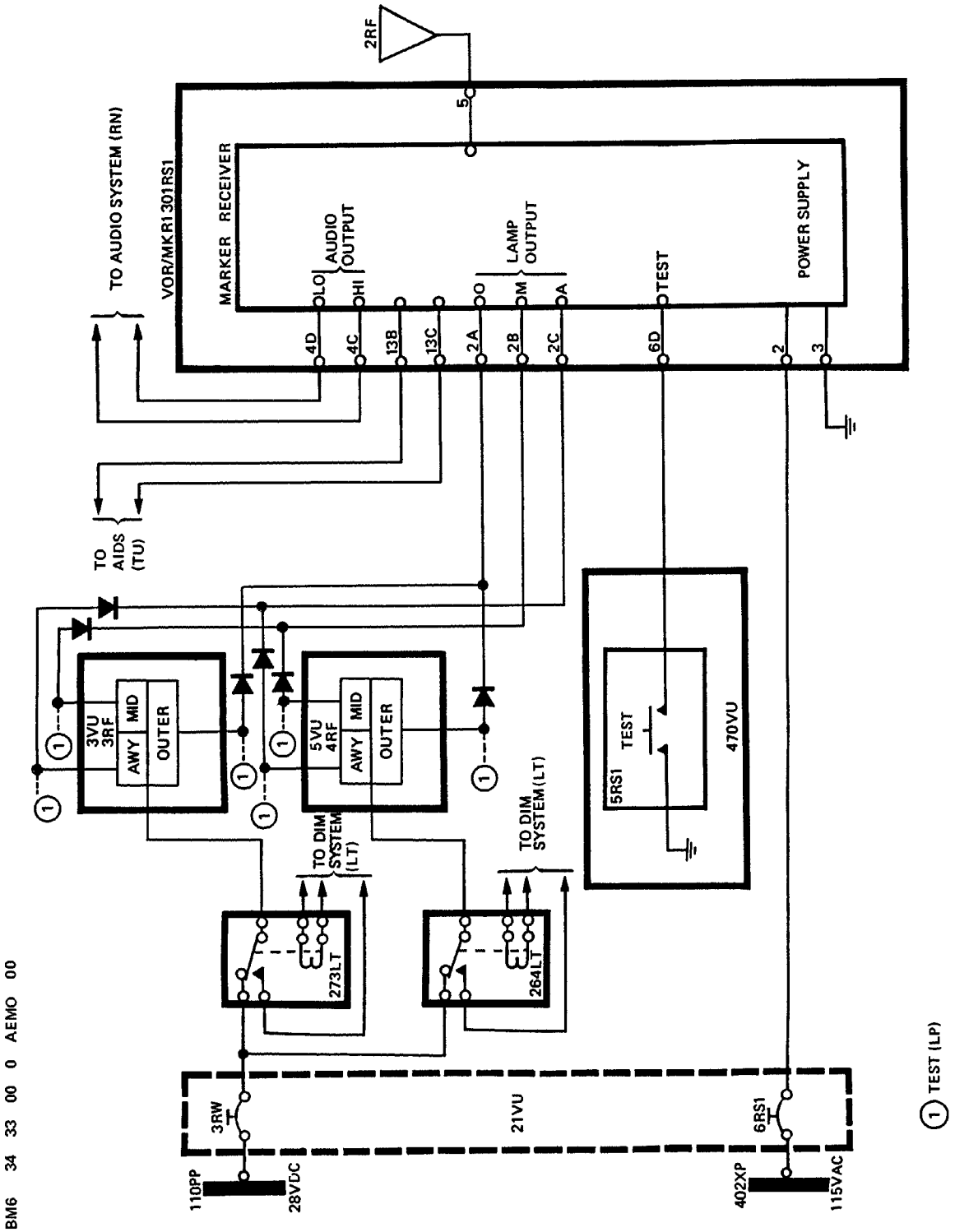
Marker Beacon System - Schematic
Figure 004



Marker Beacon System - Schematic
Figure 005

The power consumption of the receiver is 36 W and an additional 4.4 W for the annunciator lamps.
(Ref. Fig. 006)

**ON A/C 001-100,

4. Component Description

A. Marker Beacon Receiver
(1)Description (Ref. Fig. 007)
The marker beacon receiver is contained in the VOR/MKR 1 receiver unit.
The front panel of the receiver features the following indications:
- VOR (red), indicates a failure in the internal circuit of the receiver.
- VOR (green), indicates the correct functioning of the receiver.
- MKR (red), indicates the status of the MKR receiver.
- DATA IN (red), indicates the bit status of the input signal to the receiver.

It also features a TEST button to initiate the VOR/MKR function test.
An ATE connector is fitted on the rear of the unit, together with the interface connectors.
The receiver is fix-tuned to receive the 75 MHz amplitude modulated radio frequency transmitted by beacon transmitters located on the ground.

**ON A/C 101-200,

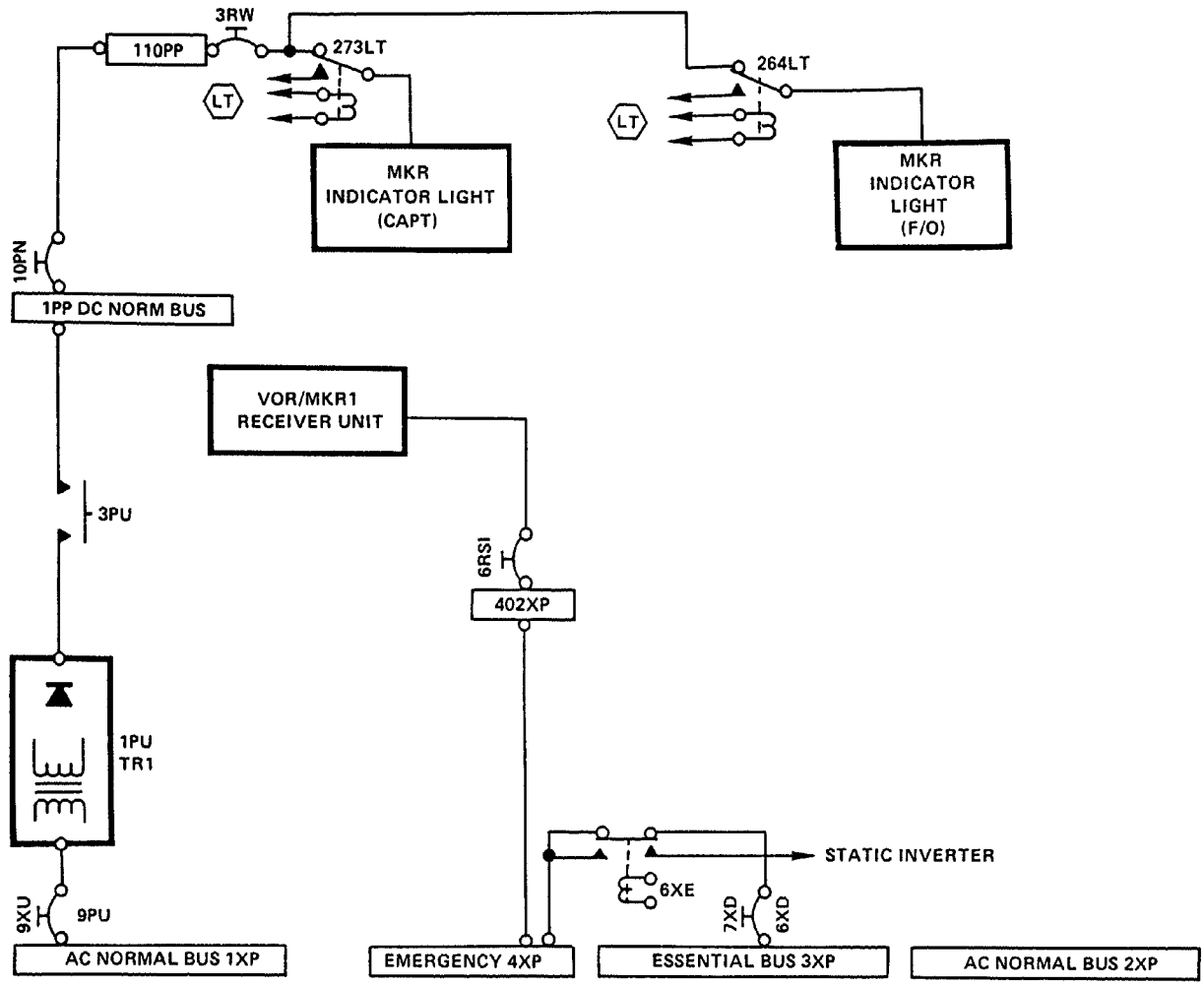
4. Component Description

A. Marker Beacon Receiver
(1)Description (Ref. Fig. 008)
The marker beacon receiver is contained in the VOR/MKR 1 receiver unit.
The front panel of the receiver features the following indications:
- CONTROL INPUT FAIL (red), indicates that no information is received at the input ports.
- LRU STATUS PASS (green), indicates that no faults are detected during self-test sequence.
- LRU STATUS FAIL (red), indicates that a fault is detected during self-test sequence.

It also features a TEST button to initiate the VOR/MKR function test.
An ATE connector is fitted on the rear of the unit, together with the interface connectors.
The receiver is fix-tuned to receive the 75 MHz amplitude modulated radio frequency transmitted by beacon transmitters located on the ground.

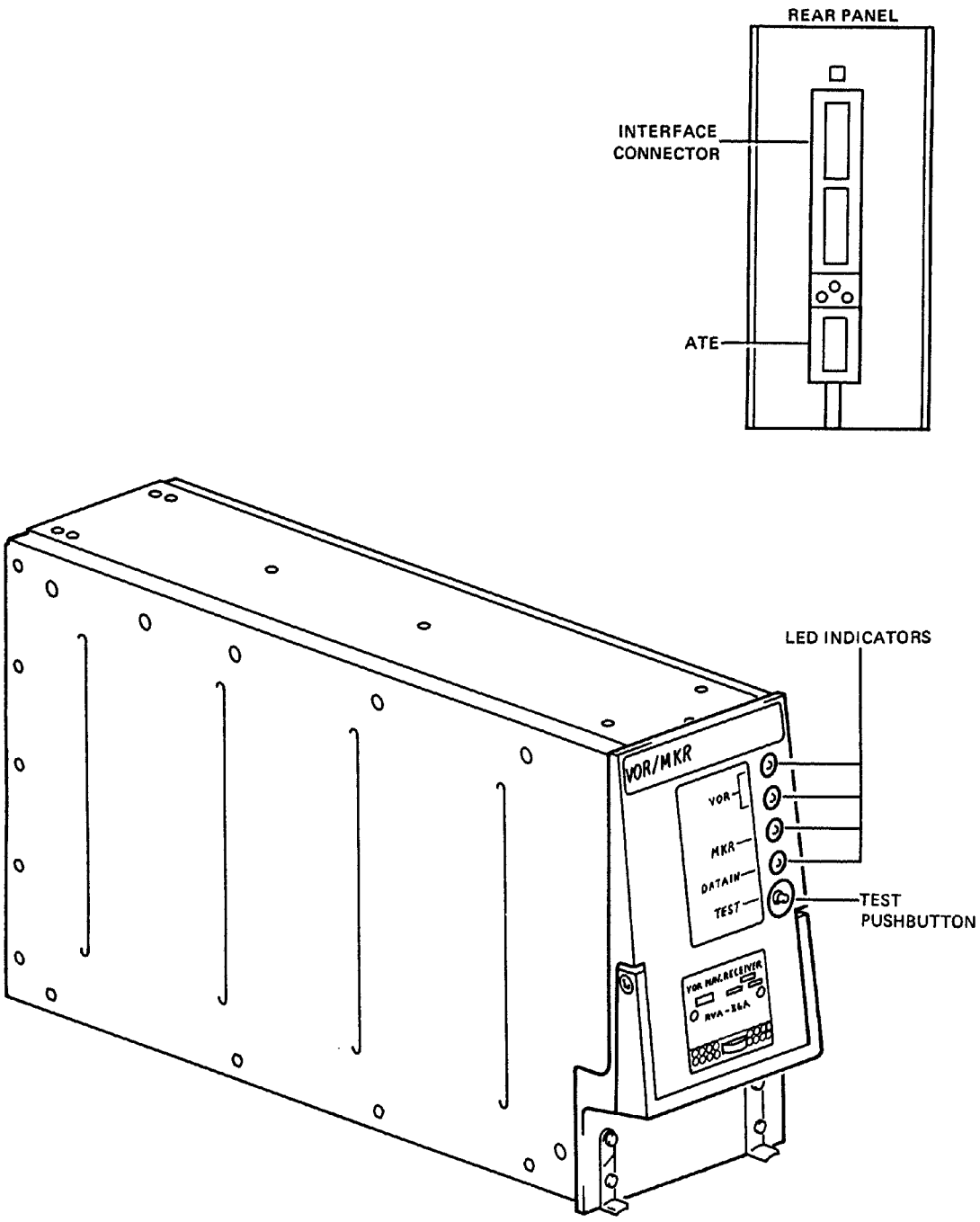
**ON A/C 001-100,

(Ref. Fig. 007)



BM6 34 33 00 0 AGDO 00

Marker Beacon System - Power Supply Block Diagram
Figure 006



BM6 34 33 00 0 AJAO 00

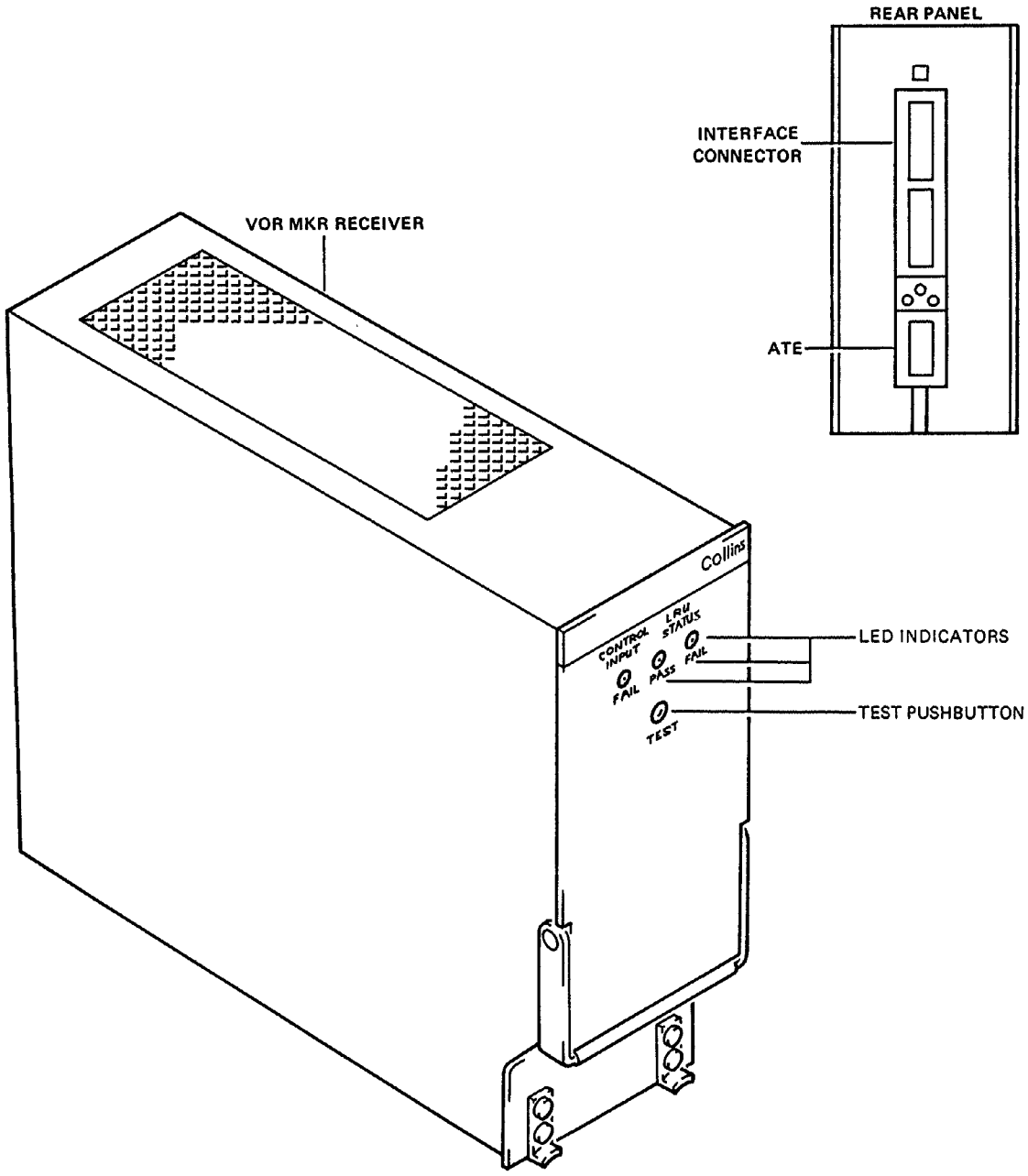
Marker Beacon System - VOR/MKR Receiver
Figure 007

**ON A/C 101-200,

(Ref. Fig. 008)

**ON A/C 001-100,

(2)Operation (Ref. Fig. 009)
The marker receiver is supplied with +15 V DC, -15 V DC and +5 V DC from the main VOR receiver.
To obtain optimum performance from the RF amplifiers, AGC circuit and the detector, a stable +12 V DC is required. In the receiver the detected 75 MHz carrier wave signal is filtered by the crystal filter. The crystal filter output is amplified in a 75 MHz preamplifier and applied to the main 75 MHz amplifier through the HI/LOW attenuator. The sensitivity attenuator receives a DC control voltage which establishes the receiver sensitivity. These control voltage levels, which are set by a variable resistor in a voltage divider network, are assigned: one for the high sensitivity condition and one for the low sensitivity condition.
NOTE : The receiver can be internally set to operate in either HI or LO sensitivity level, but the high sensitivity mode is not currently used. It will be made available pending future ARINC pin assignment for mode control function.
The output of the main amplifier is supplied to a linear detector. The detector outputs are used to control receiver gain via the AGC circuit, and to provide aural and visual indication via the audio processing circuits.
The AGC circuit maintains a constant level for aural output and lamp indication. In the audio processing circuits the outputs of the detector are amplified by an audio preamplifier and filtered by 400, 1300 and 3000 Hz filters.
For required aural outputs the tone filter outputs are applied to a final audio amplifier. At the same time the detector DC output is applied to a threshold switch, whose output is used to gate the final audio amplifier so that aural output is present only if the desired threshold has been passed.
For lamp drive, the tone filter outputs are applied to detectors, whose outputs are then used with threshold switch output to gate on the appropriate lamp driver.
A functional test is provided if an input is regenerated from the final output. The regenerated input activates the threshold switch, simultaneously the 3 tone filters are biased on to satisfy the tone detectors and illuminate the lamps.
(3)Monitoring
The monitoring system detects degradation of performance or system malfunctions and gives warning by positioning the status bit of the digital output. A detected malfunction is indicated by the red LED MKR on the front panel of the VOR/MKR 1 receiver. Monitoring operations are performed continously under microprocessor control.
For detailed monitoring operations of the combined VOR/MKR receiver



BM6 34 33 00 0 AJBO 00

Marker Beacon System - VOR/MKR Receiver
Figure 008

R EFFECTIVITY: 101-200,

PIA

refer to 34-55-00.

**ON A/C 101-200,

(2)Operation (Ref. Fig. 010)
The marker beacon receiver is a 75 MHz single-channel tuned RF receiver and consists of crystal filter, RF amplifier, envelope detector, AGC circuit, audio instrumentation and self-test oscillator.
In the receiver the detected 75 MHz carrier wave signal is filtered by a 75 MHz crystal filter. The bandwidth of the filter is +15 kHz at 30 dB and +70 kHz at 60 dB.
The filtered 75 MHz signal is amplified by a four-stage RF amplifier. Each amplifier stage is capable of up to 26 dB of gain.
The output of the last amplifier is applied to an envelope detector. The detector demodulates the marker beacon audio signal from the 75 MHz RF carrier and applies it to the AGC circuit and the marker beacon audio instrumentation. The AGC circuit monitors the detected audio signal to maintain a constant level of signal for any variations in the input signal level.
In the audio instrumentation the outputs of the detector are applied to the inputs of three audio bandpass filters with center frequencies of 400 Hz, 1300 Hz, 3000 Hz. The output of each filter is amplified, buffered and applied to:
- an audio amplifier, which is connected to the aircraft audio integrating system to provide aural identification;
- three separate rectifiers, which convert the audio signal to direct current signals. The direct current signals are filtered and applied through comparators to transistor switches. The signal level from the comparators turns on the appropriate transistor switch. The transistor completes the annunciator lamp circuit to ground.
The output from the comparators also control three bits in ARINC 429 output word for AIDS.
The marker beacon self-test oscillator is set to operation if the VOR functional self-test is enabled. It consists of the audio self-test signal generating circuit and the RF carrier generating circuit. The output of the RF carrier generating circuit is a 75 MHz RF carrier which, when mixed with the audio signal from the audio self-test signal generating circuit provides the required input for the marker beacon receiver.

**ON A/C 001-100,

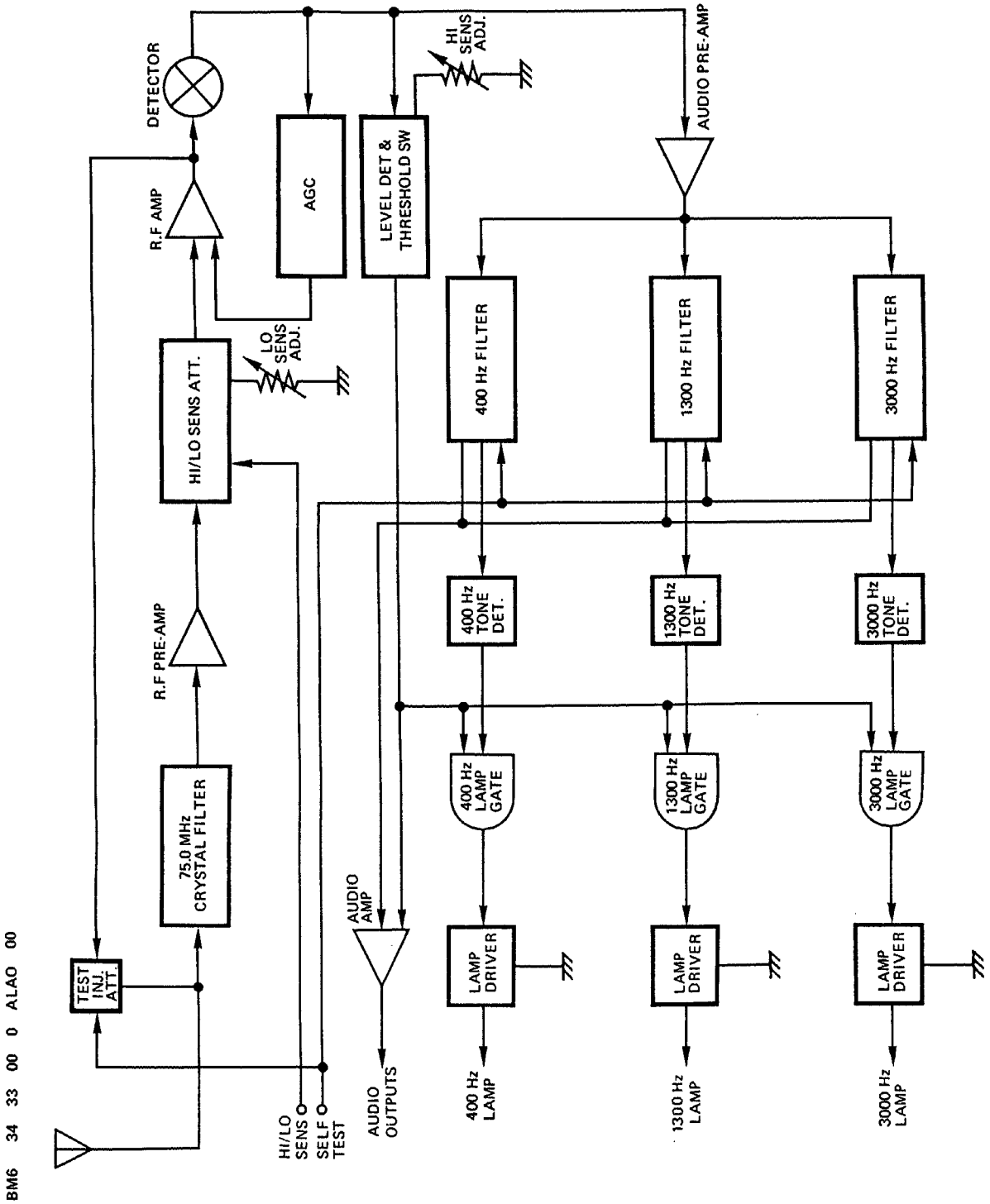
(Ref. Fig. 009)

**ON A/C 101-200,

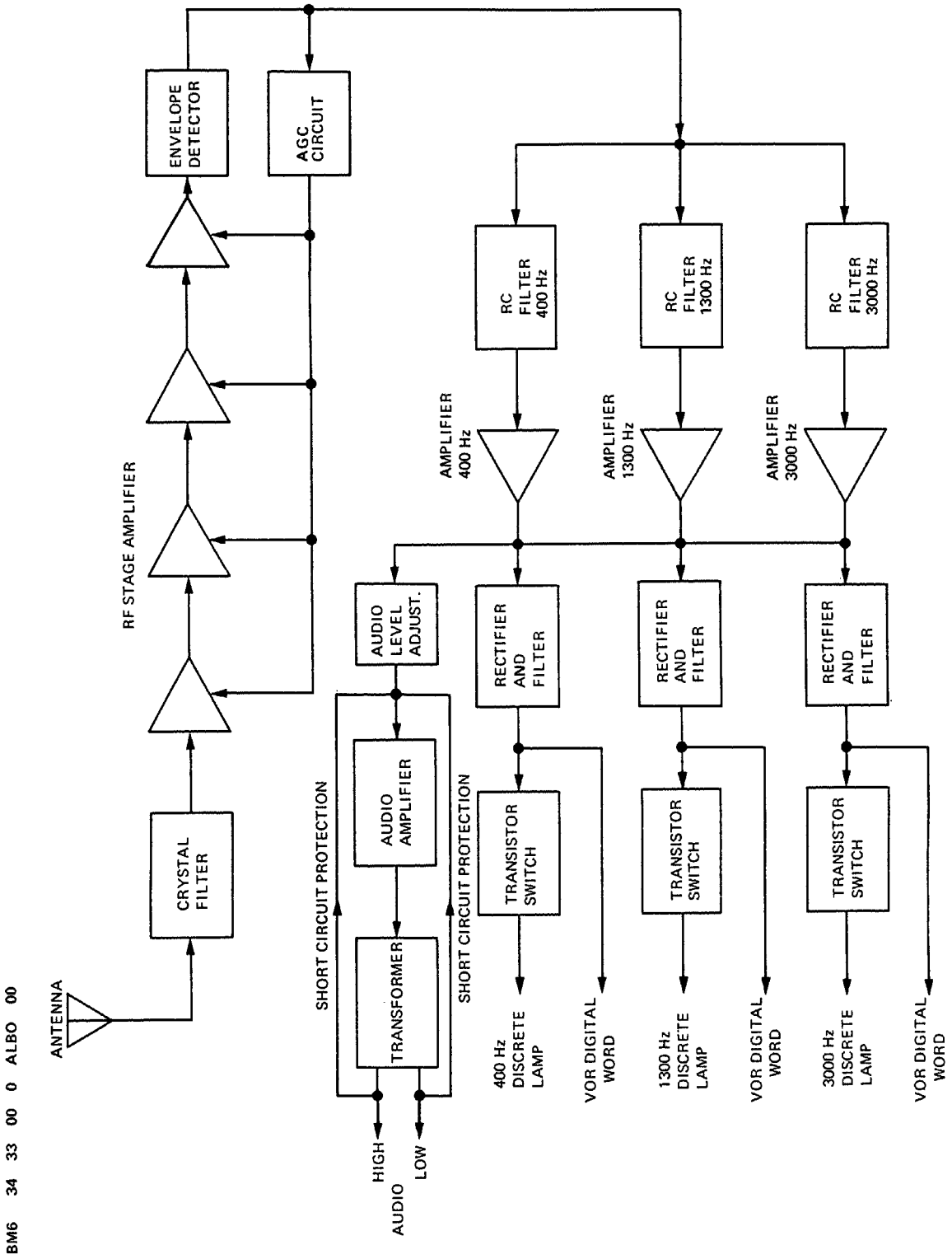
(Ref. Fig. 010)

**ON A/C ALL

B. Antenna (Ref. Fig. 011)



Marker Beacon Receiver - Block Diagram
Figure 009



Marker Beacon Receiver - Block Diagram
Figure 010

The antenna is a low-drag, light-weight antenna, located on the longitudinal axis of the aircraft on the lower part of the center fuselage (zone 130). The dielectric, foam-filled, white polyester fiberglass housing, fitted with a metal leading edge, protects the antenna against moisture and erosion. The antenna is horizontally polarized, has an impedance of 50 Ohm and is designed for reception of 75 MHz marker beacon signals. A coaxial connector is provided for connection to the marker beacon receiver.

5. System Operation

A. Energization
The MKR receiver is energized, when the busbars are supplied and the VOR/MKR 1 circuit breaker is closed. For the MKR annunciator lamp energization, the dim system must be functioning and the 3RW and 197LT circuit breakers must be closed.

**ON A/C 001-100,

B. Indication
When the aircraft passes through a marker beam, a ground return is provided to illuminate the annunciator lamps.
When the annunciator lamps come on, the blue letters 'MKR' are readable.

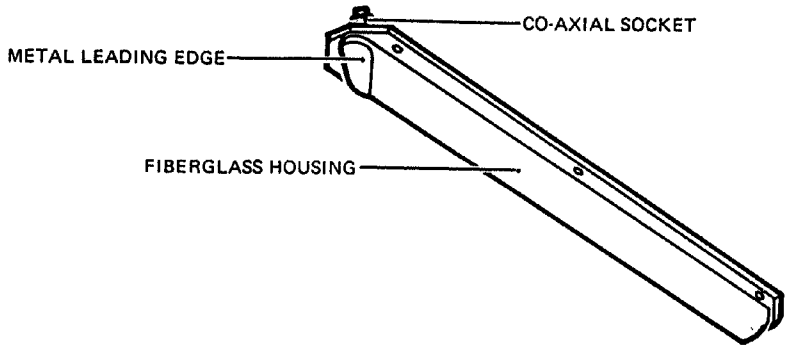
**ON A/C 101-200,

B. Indication
(1)When the aircraft passes the outer marker beam, a ground return is provided to illuminate the OUTER annunciator lamps. When the annunciator lamps come on, the blue letters 'OUTER' are readable.
(2)When the aircraft passes the middle marker beam, a ground return is provided to illuminate the MID annunciator lamps. When the annunciator lamps come on, the amber letters 'MID' are readable.
(3)When the aircraft passes the airways marker beam, a ground return is provided to illuminate the AWY annunciator lamps. When the annunciator lamps come on, the white letters 'AWY' are readable.

**ON A/C ALL

C. Lighting
The brightness of the annunciator lamps can be varied by using the switch 'TEST/BRT/DIM' on the 'ANN LT' panel 436VU.

D. Audio Control
The marker audio signal is audible in the headsets and loudspeakers controlled by the audio integrated system (MKR button must be pressed and adjusted to the required volume).



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Marker Beacon System - Antenna
Figure 011

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**ON A/C 001-100,

6. Test

A. Annunciator:
(1)The lamp test is accomplished by switching the 'TEST/BRT/DIM' switch to 'TEST' and pressing the 'AUTOTEST' button on the 'ANN LT' panel 436VU.

B. Receiver:
(1)When the pushbutton test switch VOR/MKR 1 on the AVIONICS SYS TEST panel 470VU is depressed and held:
- the blue MKR indicator lights on the main instrument panel come on for approximately 6 sec.
- neither of the audio tones, corresponding to the 400 Hz, 1300 Hz or 3000 Hz modulation, is heard on the headsets and/or the flight compartment loudspeakers.

(2)A similar test can be carried out by depressing and holding the test pushbutton on the front panel of the VOR/MKR 1 receiver unit. The LEDs on the LRU front panel will all come on for approx. 3 sec., then go off for approx. 2 sec., then the VOR LED comes on green for 4 sec. approx. If the marker receiver fails the self-test, the red LED MKR comes on.

**ON A/C 101-200,

6. Test

A. Annunciator:
(1)The lamp test is accomplished by switching the 'TEST/BRT/DIM' switch to 'TEST' and pressing the 'AUTOTEST' button on the 'ANN LT' panel 436VU.

B. Receiver:
(1)The self-test (BITE) is activated by pressing and holding the VOR/MKR 1 button on the AVIONICS SYS TEST panel 470VU.
- the blue, amber and white MKR indicator lights on the main instrument panel come on for approx. 16 sec.
- audio tones corresponding to the 400 Hz, 1300 Hz and 3000 Hz modulation, are heard on the headsets and/or the flight compartment loudspeakers.

(2)A similar test can be carried out by depressing and holding the test pushbutton on the front panel of the VOR/MKR 1 receiver unit.
- the three LEDs come on for approx. 3 sec., then go off for a period of 3 sec., then the green LED LRU STATUS PASS comes on for approx. 10 sec.
- the red LED CONTROL INPUT FAIL comes on if the VOR/MKR is not receiving any information.
- the red LED LRU STATUS FAIL comes on if a fault is detected during the self-test sequence.
- the green LED LRU STATUS PASS comes on if no faults are detected

during the self-test sequence.

1. Operational Test

A. Reason for the Job
(1)To ensure that the marker receiver is operating correctly.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz
(2)	Headset (600 Ω)

Referenced Procedures

- 23-51-00, P. Block 501	Audio Integrating
- 24-41-00, P. Block 301	AC External Power Control

C. Procedure
(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Energize the audio integrating system (Ref. 23-51-00, P. Block 501).
(d)Connect a headset to associated connector on the Captain's jack box.
(e)Make certain that the following circuit breakers are closed:

	PANEL	SERVICE	IDENT	LOCATION
R	21VU	RADIO NAV & COM/NAV CTL PNL LT & SELCAL	3RW	D 6
R	21VU	RADIO NAV & COM/VOR 1	6RS1	C 2
	132VU	INT LT/ANN LT/TEST/MAN	1LP	L80
	132VU	INT LT/ANN LT/TEST/MAN	2LP	L81
	132VU	INT LT/ANN LT/TEST/MAN	149LP	L82
	132VU	INT LT/ANN-LT/TEST/AUTO	153LP	M83
	132VU	INT LT/ANN LT/DIM	197LT	L84
	132VU	INT LT/ANN LT/DIM	198LT	L83

(f)Select MARKER mode on Captain's audio selector panel.

**ON A/C 001-100,

(2)Test

ACTION	RESULT
1. On overhead panel 436VU: - place annunciator light test switch in TEST position.	On instrument panels 3VU and 5VU: - blue MKR annunciator lights 3RF and 4RF come on.

ACTION	RESULT
- place annunciator light test switch in **BRT** position.	- **MKR** annunciator lights go off.
2. On panel **47OVU**: - press and hold **AVIONICS SYS TEST/VOR MKR 1** pushbutton.	On panels **3VU** and **5VU**: - blue **MKR** annunciator lights come on for approx. **6** seconds, then go off. In headset: - audio tones are not heard.
- release **AVIONICS SYS TEST/VOR MKR 1** pushbutton.	

R ****ON A/C 101-200,**

(2)Test

ACTION	RESULT
1. On overhead panel **436VU**: - place annunciator light test switch in **TEST** position. - place annunciator light test switch in **BRT** position.	On instrument panels **3VU** and **5VU**: - blue **MKR** annunciator lights **3RF** and **4RF** come on. - **MKR** annunciator lights go off.
2. On lateral panel **47OVU**: - press and hold **AVIONICS SYS TEST/VOR MKR 1** pushbutton.	On panels **3VU** and **5VU**: - blue **MKR** annunciator lights come on for approx. **16** seconds then go off. In headset: - audio tones are heard.
- release **AVIONICS SYS TEST/VOR MKR 1** pushbutton.	

R ****ON A/C 001-100,**

3. On **Marker/VOR** receiver 1 front panel: - press and hold **TEST** pushbutton.	On **Marker/VOR** receiver 1 front panel: - for approx. **3** seconds all **LEDs** come on. - for the next 2 seconds approx., all **LEDs** go off. - for the last **4** seconds approx., the green **LED, VOR,** comes on, if no faults are detected during the self-test sequence. - the red **LED MKR** comes on, if a **MKR** fault is detected during the self-test sequence.

ACTION	RESULT
	- after approx. 10 seconds testing, LED goes off.
- release TEST pushbutton.	

R **ON A/C 101-200,

3. On Marker/VOR receiver 1 front panel: - press and hold TEST pushbutton.	On Marker/VOR receiver 1 front panel: - for approx. 3 seconds all LEDs come on. - for the next 3 seconds approx., all LEDs go off. - for the last 10 seconds approx., the green LED, LRU STATUS PASS, comes on, if no faults are detected during the self-test sequence. - the red LED, LRU STATUS FAIL, comes on, if a fault is detected during the self-test sequence. - after approx. 16 seconds testing, LED goes off.
- release TEST pushbutton.	

R **ON A/C ALL

(3)Close-Up
(a)Disengage MKR mode on the audio selector panels.
(b)Remove headset from captain's jack box.
(c)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(d)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

2. Functional Test

A. Reason for the Job
(1)To ensure correct operation of the marker beacon system.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz
(2)	Headset (600 Ω)
(3)	Marker Ground Test Unit with Interconnection Cables

Referenced Procedures
- 23-51-00, P. Block 501 Audio Integrating
- 24-41-00, P. Block 301 AC External Power Control

C. Procedure
(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Energize the audio integrating system (Ref. 23-51-00, P. Block 501).
(d)Connect a headset to each audio integrating system jack box.
(e)Make certain that the following circuit breakers are closed:

	PANEL	SERVICE	IDENT.	LOCATION
R	21VU	RADIO NAV & COM/NAV CTL PNL LT & SELCAL	3RW	D6
R	21VU	RADIO NAV & COM/VOR 1	6RS1	C2

(f)MARKER ground test unit.
1 Place marker ground test unit beneath fuselage near marker antenna.
2 Switch on ground test unit.
3 Connect test marker antenna to corresponding connector.
(g)Select MARKER mode on each audio selector panel.

(2)Test

ACTION	RESULT
1. On the ground test unit: - set controls to transmit on the marker frequency of 75 MHz with a 400 Hz modulation frequency.	On instrument panels 3VU and 5VU: - blue MKR annunciator lights 3RF and 4RF come on. In headsets: - audio tone corresponding to the 400 Hz modulation is heard.
- change modulation frequency to 1300 Hz.	On panels 3VU and 5VU: - blue MKR annunciator lights 3RF and 4RF go off during frequency change and come on again at 1300 Hz. In headsets: - audio tone corresponding to the 1300 Hz modulation is heard.
- change modulation frequency. to 3000 Hz.	On panels 3VU and 5VU: - blue MKR annunciator lights go off during frequency change and come on again at 3000 Hz. In headsets: - audio tone corresponding to the 3000 Hz modulation is heard.

ACTION	RESULT
- switch off ground test unit.	On panels 3VU and 5VU: - MKR annunciator lights go off. In headsets: - audio tone stops.

(3)Close-Up
(a)Disengage MKR mode on the audio selector panels.
(b)Remove headsets from jack boxes.
(c)Remove MARKER ground test equipment.
(d)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(e)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

MARKER ANTENNA - REMOVAL/INSTALLATION

WARNING : CLEANING AGENT (MAT. NO. 11-003) IS DANGEROUS. AVOID INHALING FUMES. USE IN WELL VENTILATED AREA ONLY. IT IS HIGHLY FLAMMABLE AND A SKIN IRRITANT. WEAR PROTECTIVE GLOVES OR USE A BARRIER CREAM. WASH IMMEDIATELY WITH CLEAN WATER, IF SKIN IS SPLASHED WITH SOLVENT.

1. Equipment and Materials

ITEM	DESIGNATION	
A. Material No. 05-013	Special Materials (Ref. 20-31-00)	M
B. Material No. 09-019	Sealants (Ref. 20-31-00)	M
C. Material No. 11-003	Cleaning Agents (Ref. 20-31-00)	M
D. Material No. 16-003	Structure Paints (Ref. 20-31-00)	M
E.	Blanking Cap	
Referenced Procedure		
- 20-28-11, P. Block 1	Electrical Bonding - General	D
- 34-33-00, P. Block 501	Marker Beacon System	D

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breaker:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/VOR 1	6RS1	C 2

(Ref. Fig. 401)

B. Removal

WARNING : CLEANING AGENT (MAT. NO. 11-003) IS DANGEROUS.

(1)Remove screws (2).

(2)Separate antenna (3) from fuselage enough to disconnect connector (1).

(3)Remove antenna (3).

(4)Fit blanking cap to connector (1).

(5)Remove old sealant from fuselage, using cleaning agent (Mat. No. 11-003).

C. Installation

(1)Apply separating agent (Mat. No. 05-013) to mounting surfaces of antenna and fuselage.

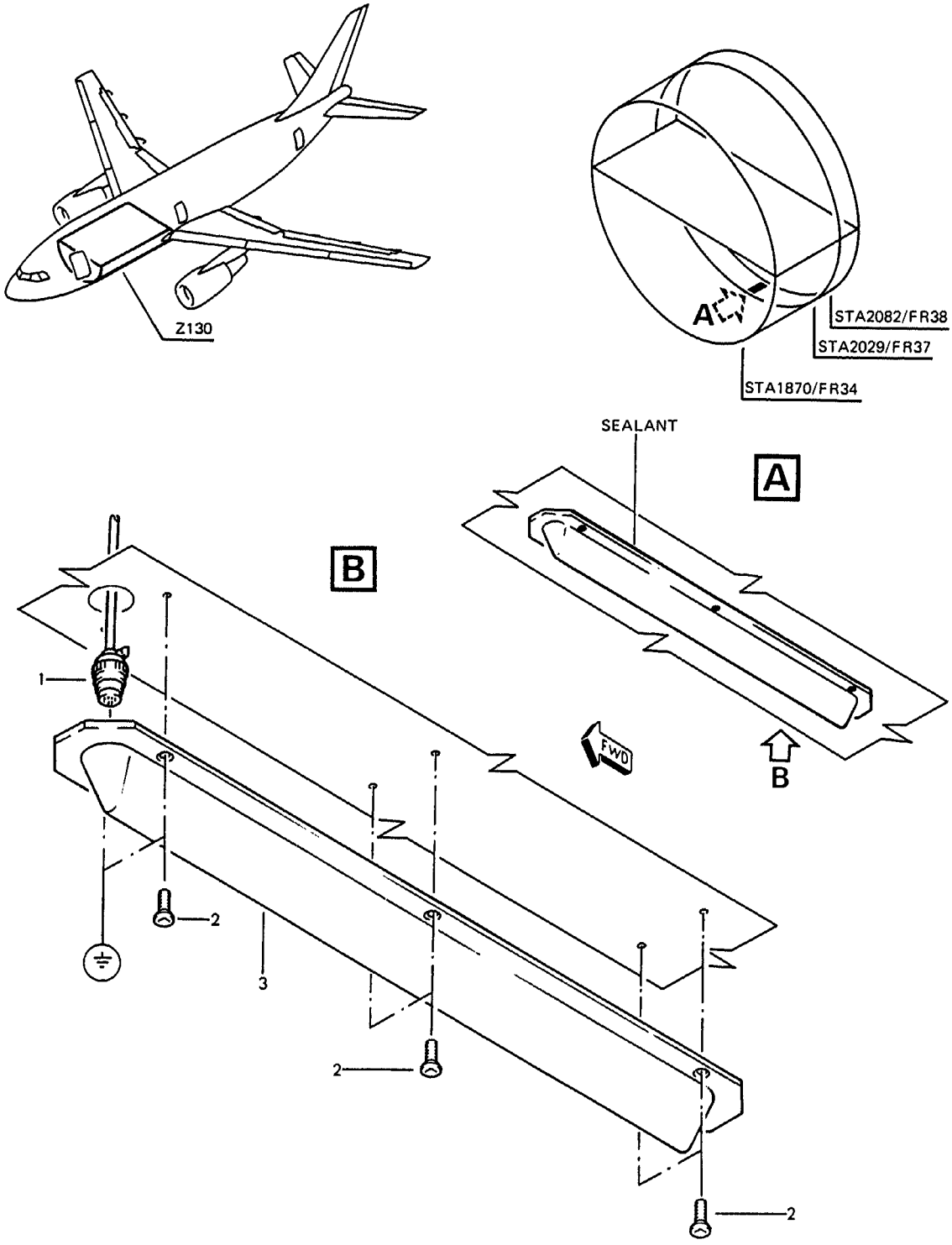
(2)Apply sealant (Mat. No. 09-019) to mounting surfaces of antenna and fuselage.

NOTE : Keep ground connections clean of sealant.

(3)Remove blanking cap from connector (1) and connect to antennna (3).

(4)Position antenna (3) and install on fuselage, using screws (2).

(5)Measure the bonding contact resistance between the antenna (3) and the fuselage structure (Ref. Task 20-28-11, P. Block 1).



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Marker Antenna
Figure 401

NOTE : Make sure that the bonding contact resistance is not more than 5 milliohms.

(6)Remove excess sealant.
(7)After sealant has cured, apply structure paint (Mat. No. 16-003).
NOTE : It is not mandatory to paint the sealant around the base of the antenna and on the head of the screws.
(8)Remove safety clip and tag and close circuit breaker 6RS1.

D. Test
(1)Carry out marker beacon system operational test (Ref. 34-33-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

1. General

**ON A/C 001-003,

(Ref. Fig. 001)

R **ON A/C 004-200,

(Ref. Fig. 002)

**ON A/C ALL

The aircraft is equipped with two ILS receivers. The function of the instrument landing system is to measure deviations between aircraft flight path and glide slope, and between aircraft flight path and runway alignment plane (localizer).
The localizer operates in a frequency band ranging from 108.1 MHz to 111.95 MHz. The glide operates in a frequency band ranging from 329.15 MHz to 335 MHz.
To capture these frequencies, it is necessary to select LOC transmitter frequency on the ILS control box, the glide frequency being automatically selected.

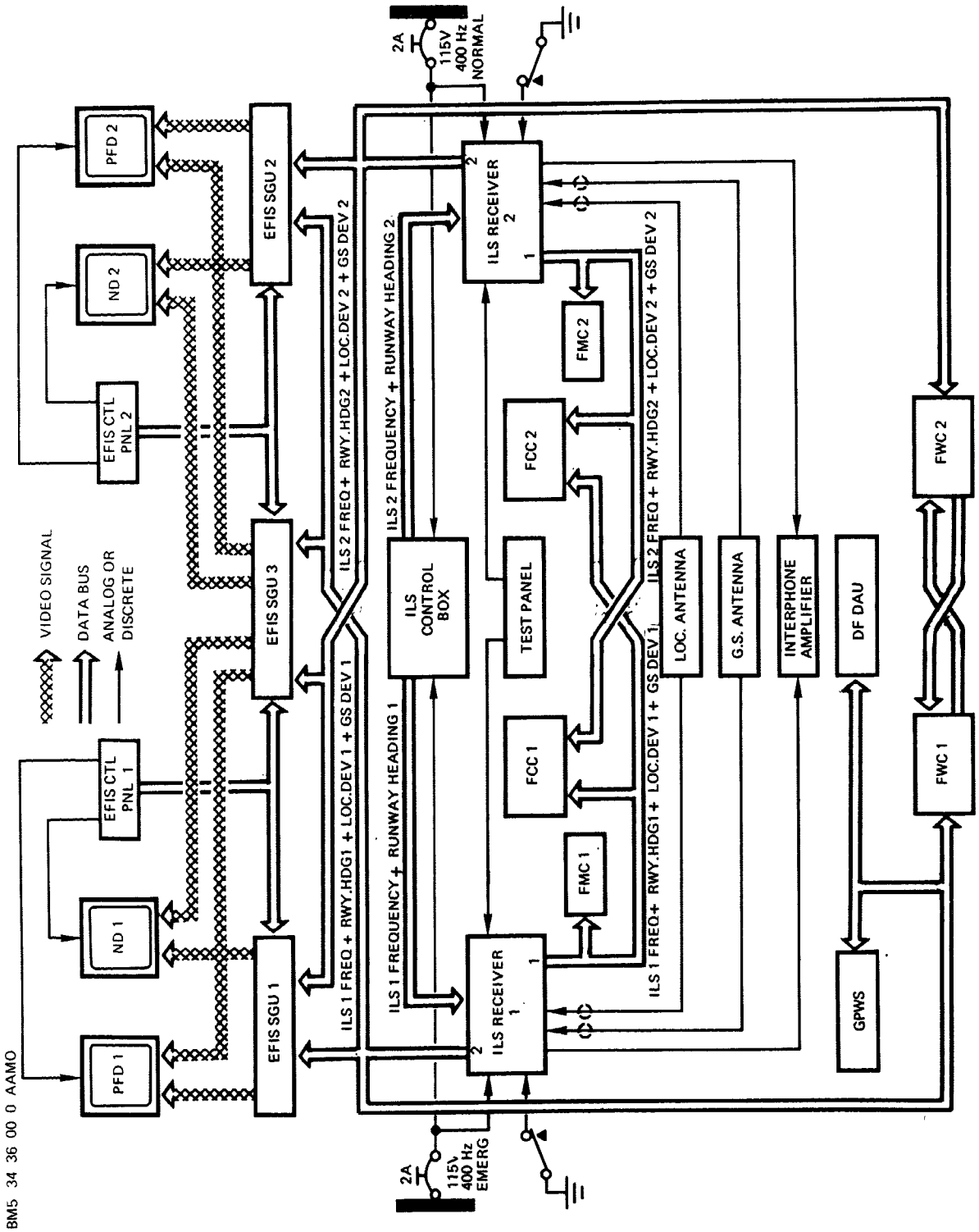
2. Component Location

(Ref. Fig. 003)
(Ref. Fig. 004)
(Ref. Fig. 004)

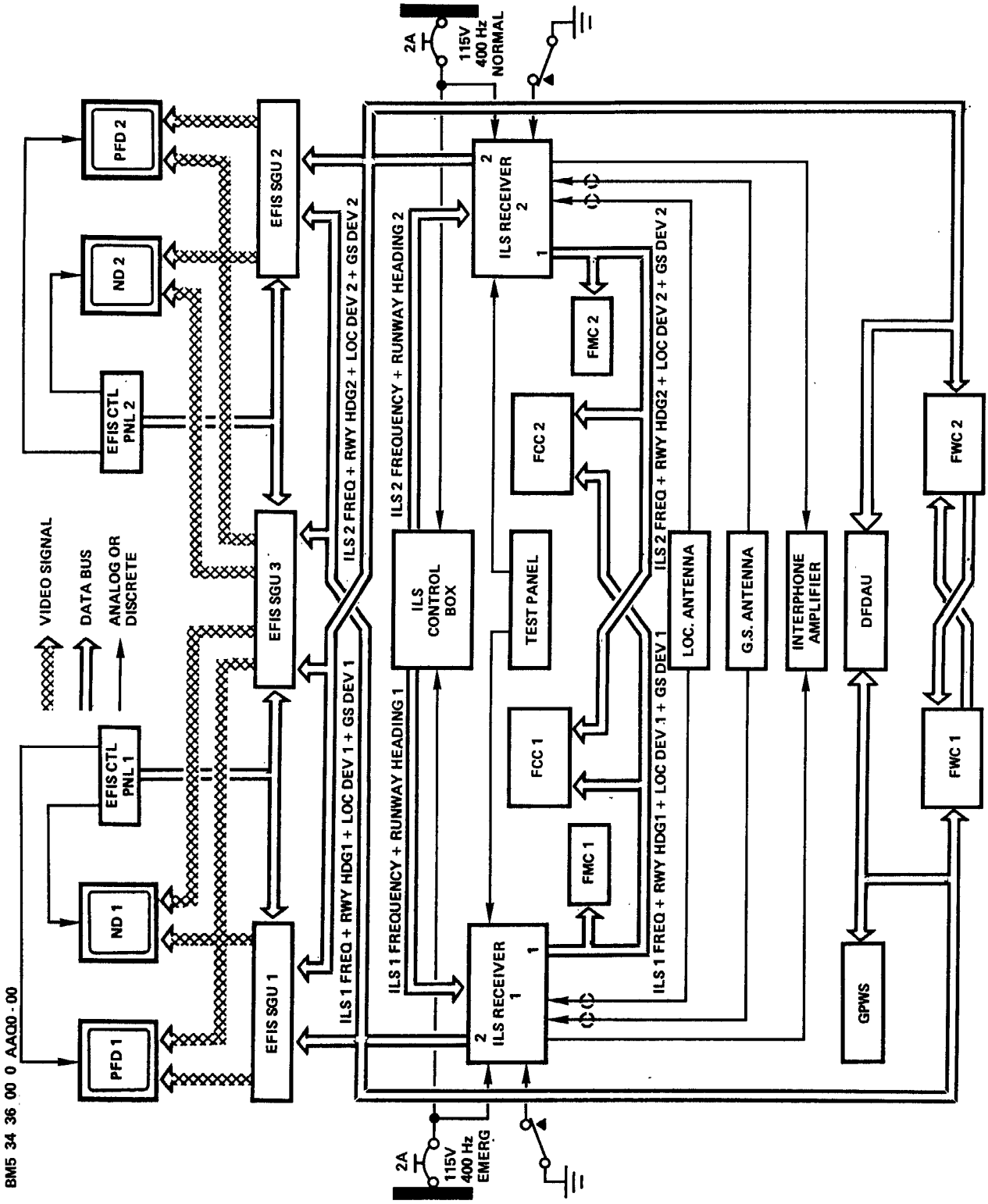
FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
1RT1	RECEIVER-ILS,1	85VU	121	121BL	34-36-31
1RT2	RECEIVER-ILS,2	86VU	121	121BL	34-36-31
3RT	ANTENNA-LOCALIZER		110	110AL	34-36-11
4RT	ANTENNA-GLIDE/SLOPE		120	121AL	34-36-41
33RT1	P/BSW-AVIONICS SYS TEST/ILS1	470VU	212		
33RT2	P/BSW-AVIONICS SYS TEST/ILS2	470VU	212		
34RT	CONTROL BOX-ILS	11VU	210		34-36-15
33FN1	SWITCH-VOR/NAV/ILS	413VU	211		
33FN2	SWITCH-VOR/NAV/ILS	412VU	212		
34FN1	PFD-CAPT	3VU	211		34-74-22
34FN2	PFD-F/O	5VU	212		34-74-22
36FN1	ND-CAPT	3VU	211		34-75-22
36FN2	ND-F/O	5VU	212		34-75-22

The Instrument Landing System includes two systems controlled from a single control box featuring two output channels.

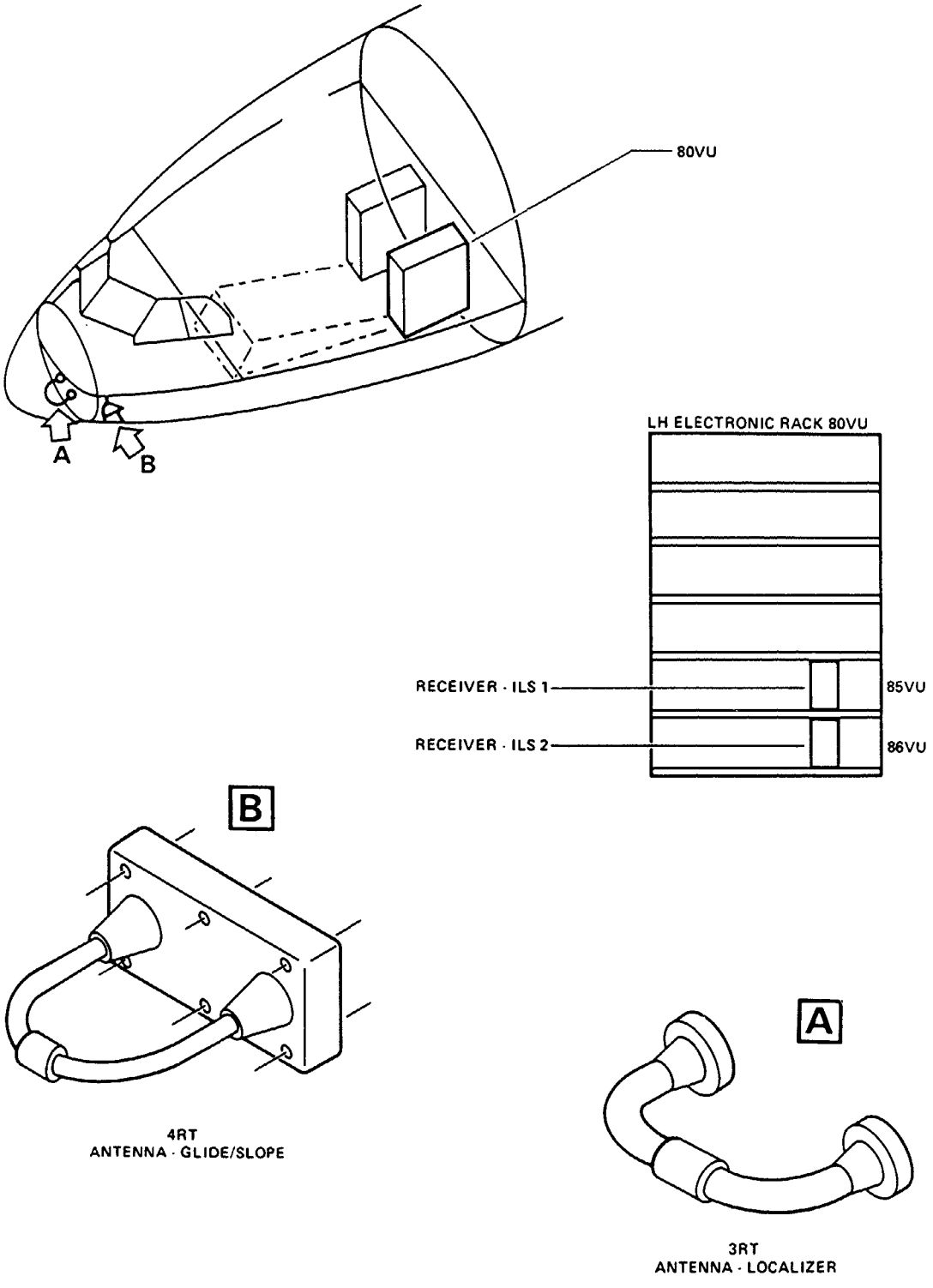
All the data is displayed on the EFIS tubes. The deviations given by the ILS 1 receiver are displayed on CAPT PFD and F/O ND, those given by the ILS2



ILS Block Diagram
Figure 001

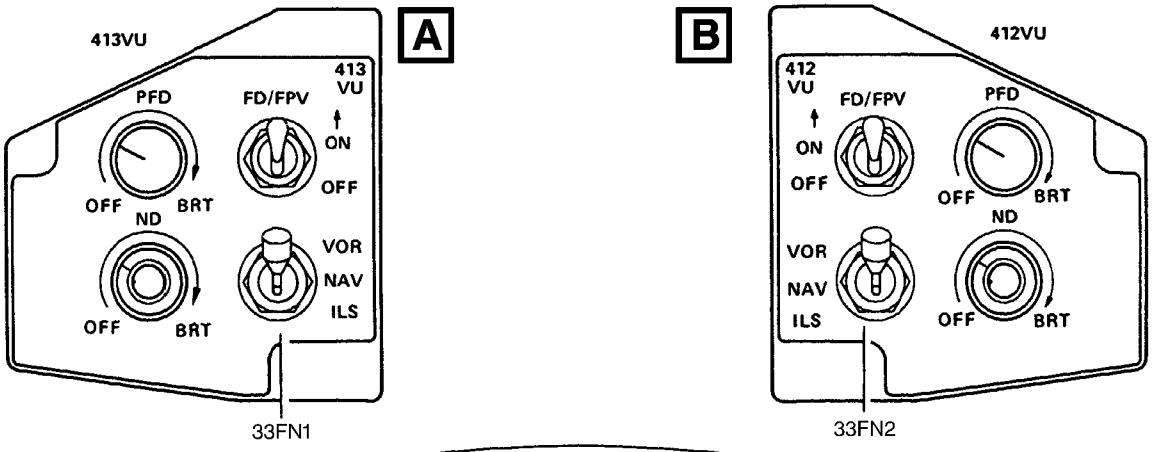


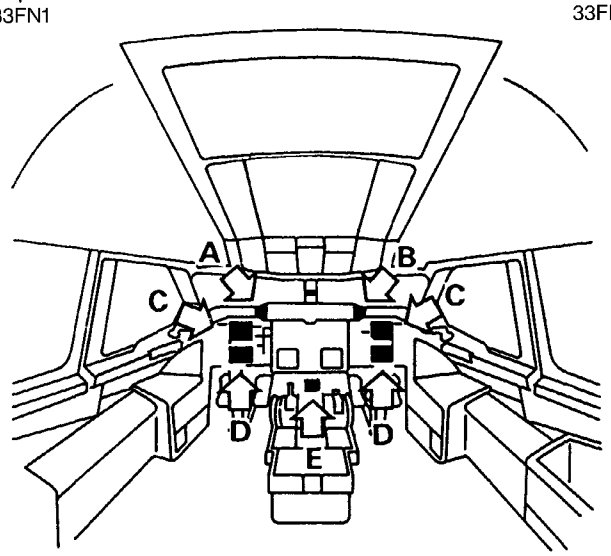
ILS Block Diagram
Figure 002

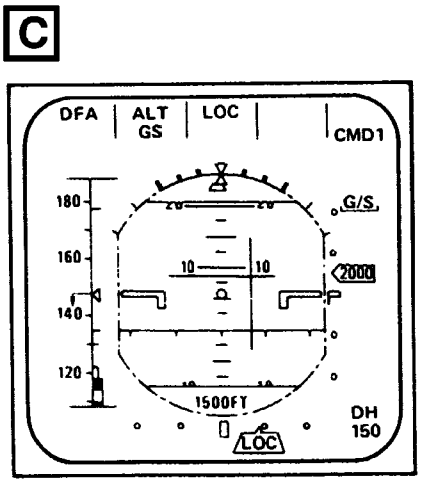


BM5 34 36 00 0 ACMO 13 08
DM5

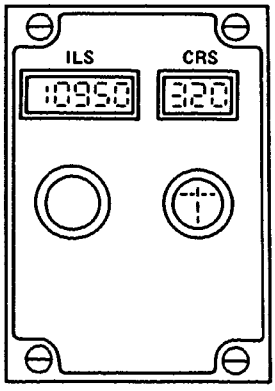
Component Location in Avionics Compartment
Figure 003



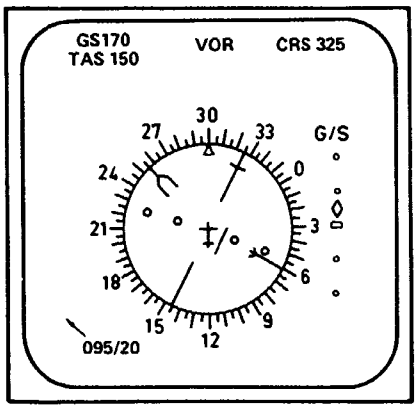




CAPT AND F/O PFD'S
34FN1/34FN2



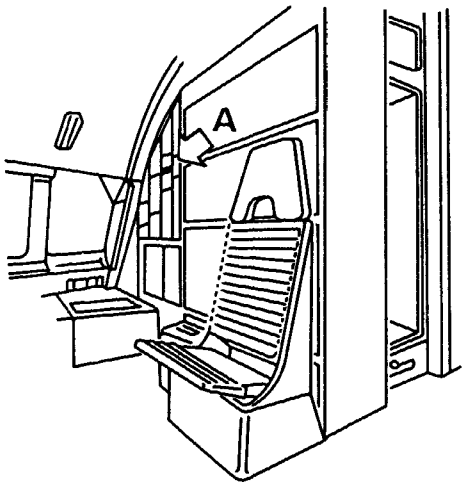
CONTROL BOX - ILS
34RT

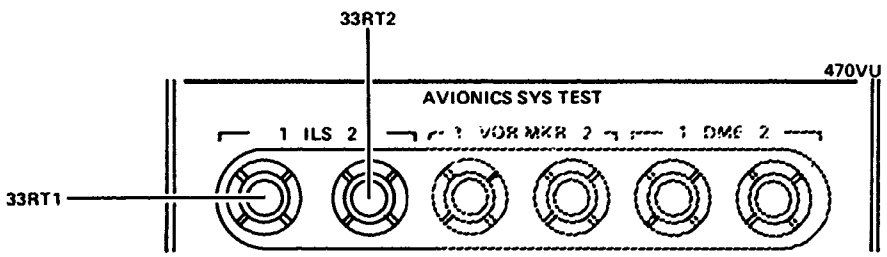


CAPT AND F/O ND'S
36FN1/36FN2

BM5 34 36 00 0 TGPA 02

Component Location in Flight Compartment (Sheet 1/2)
R Figure 004





BM5 34 36 00 0 TGPM 01

Component Location in Flight Compartment (Sheet 2/2)
Figure 004

R

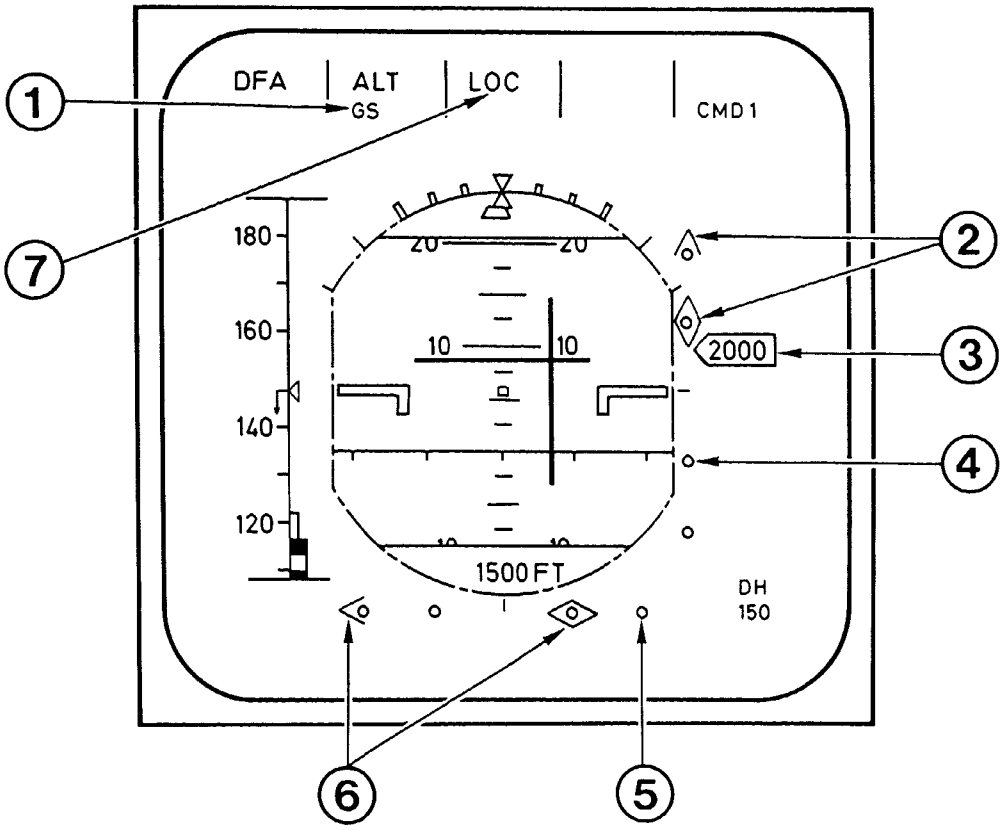
receiver are displayed on F/O PFD and CAPT ND.

3. System Power Supply
The system is supplied only with 115 V/400 Hz normal power through bus bar 205 XPA for ILS2 receiver and ultimate emergency through bus bar 401 XP for ILS1 receiver. The control box is supplied with both normal and ultimate emergency 115 Volts.
The power consumption of each receiver is less than 30 W.

4. Utilization Technical Data

A. Data Display
(1)On the PFDs
(Ref. Fig. 005)
(Ref. Fig. 006)

The vertical and lateral deviation scales are white with the scale origin yellow. These scales come into view on the PFD and a magenta mobile index moves along the scales.
When the data represented by the index is not available (no computed data) the index is not displayed.
On the contrary, when the index is against one stop, only one half of it is in view (the outer half-index).
The nature and the origin of deviation data depend on the position of VOR-ILS mode selector switch.
If this switch is in VOR position, and if LAND mode is selected on the AFS, an amber ILS message (3 mm) flashes at the intersection of both scales to order the pilot to return VOR-ILS mode selection switch to ILS position.
Vertical deviation :
The scale displays a classical glide slope deviation. It is linear.
There is a ± 0.175 ddm (150 μA) deviation between the two extreme dots.
As long as the glide beam is not captured, the glide index is not displayed. The glide stop is located at 0.2 ddm.
The G/S index and the scale flash permanently if the beam deviation is excessive. In the event of glide failure, G/S index goes out of view and a red G/S failure warning message (3mm) comes into view against the upper stop of the scale when the ILS mode is selected. An ILS1 (or ILS2) FAULT indication is transmitted to the FWC in all cases.
Lateral deviation :
The scale displays a classical LOC deviation. There is a ± 0.155 ddm (150 μA) deviation.
As long as the LOC is not captured, the LOC index is not displayed and the scale remains empty.
When the LOC index is against stop (deviation greater than or equal to 0.186 ddm) only one half of it is displayed.
The LOC index and the scale flash permanently to display excessive deviation warning.
In the event of failure, the index goes out of view and a red LOC failure warning message is displayed in middle position on the scale if ILS mode is selected. In all cases ILS1 (or ILS2) FAULT bit is set to status 0.



·1· GS ARMED ANNUNCIATOR :
THIS CYAN GS ANNUNCIATOR APPEARS WHEN THE AUTO-PILOT IS ARMED IN GS MODE.

2· GLIDE SLOPE INDEX :
THIS GREEN INDEX DISPLACES AGAINST THE VERTICAL DEVIATION SCALE.
ONLY HALF AN INDEX IS PRESENTED WHEN THE DEVIATION IS AT THE UPPER OR LOWER LIMIT OF THE SCALE.

·3· ALTITUDE SELECTED INDEX .
THIS CYAN INDEX REPRESENTS STANDARD ALTITUDE IN STANDARD OPERATION AND SELECTED ALTITUDE IN ALTITUDE MODE. IT DISPLACES AGAINST THE VERTICAL DEVIATION SCALE.

·4· VERTICAL DEVIATION SCALE :
IN GLIDE OPERATION, A TWO-DOT DEVIATION REPRESENTS 0.175 DDM.

·5· LATERAL DEVIATION SCALE :
IN LOC OPERATION, A TWO-DOT DEVIATION REPRESENTS 0.155 DDM.

·6· LOC DEVIATION INDEX :
THIS GREEN INDEX DISPLACES AGAINST THE LATERAL DEVIATION SCALE. ONLY HALF AN INDEX IS PRESENTED WHEN THE DEVIATION IS AT THE UPPER OR LOWER LIMIT OF THE SCALE

·7· LOC ENGAGED ANNUNCIATOR
THIS GREEN LOC ANNUNCIATOR APPEARS WHEN THE AUTO-PILOT IS ENGAGED IN LOC MODE.

BM5 34 36 00 0 AFMO 08 03
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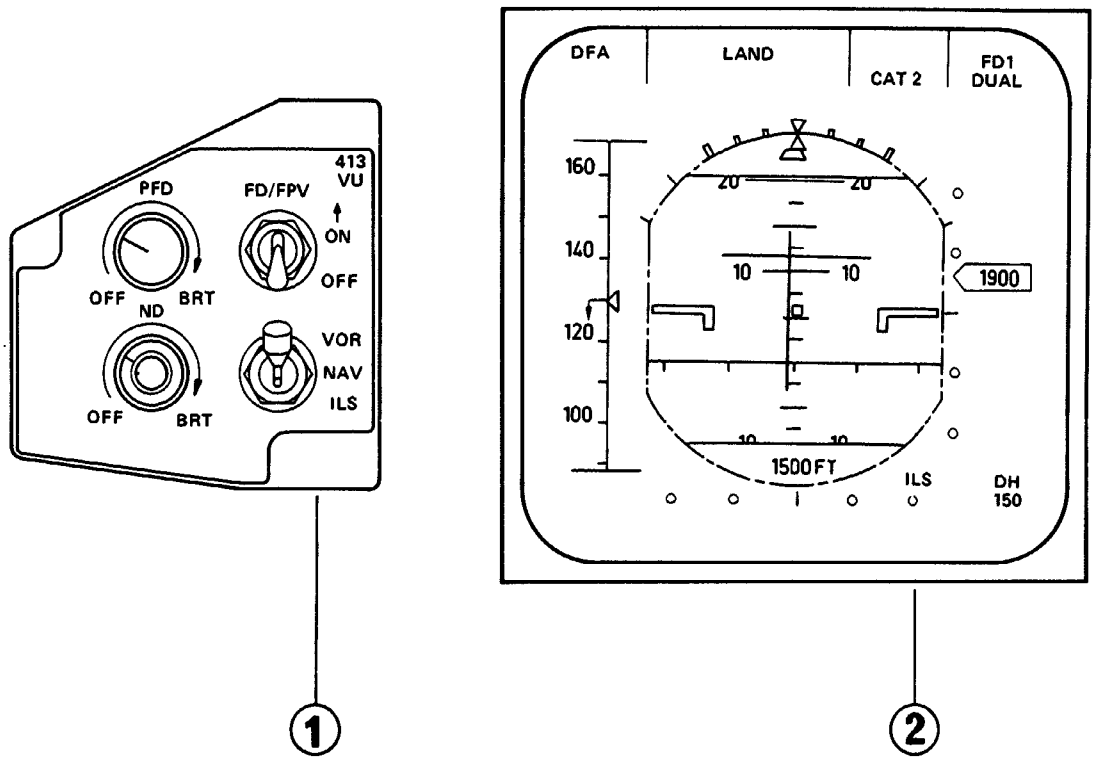
PFD - ILS Displays
Figure 005



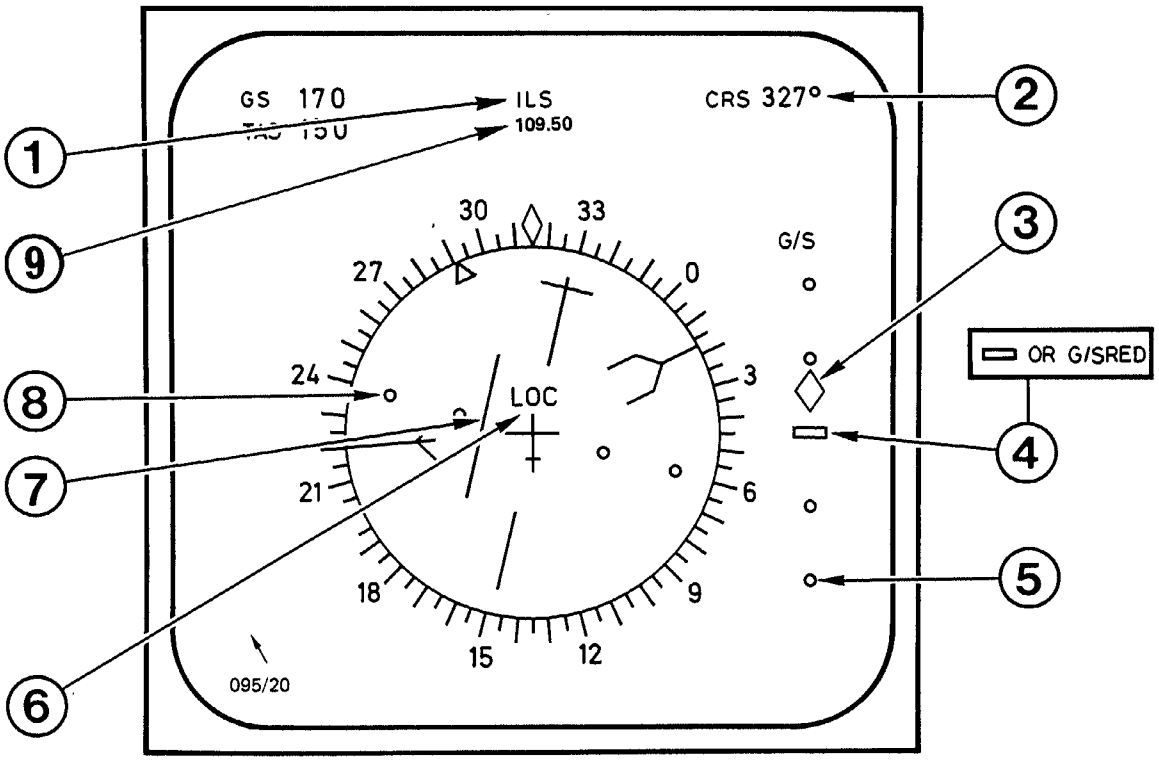
- 1 - VOR/ILS MODE SELECTOR SWITCH
THIS SWITCH ENABLES THE SELECTION OF VOR OR ILS MODE OF OPERATION ON THE PFD AND ND.

- 2 - ILS REMINDER :
THIS AMBER ILS INDICATION FLASHES, WHEN LAND MODE IS ENGAGED, AND WHEN VOR/ILS MODE SELECTOR SWITCH IS STILL IN VOR POSITION.

BM5 34 36 00 0 AHMO - 08 - 03
DM5

VOR/ILS Switching Control and Display
Figure 006

(2)On the NDs
(Ref. Fig. 007)
Lateral deviation :
The scale is white and is perpendicular to selected course symbol. The deviation is indicated by the center part of the course symbol. The stop is on the second dot of the scale.
The LOC deviation displayed is the classical LOC deviation (± 0.155 ddm, i.e ± 150 μA between the two extreme dots).
The deviation bar and the scale flash in the event of excessive deviation warning. If the deviation is not computed (no computed data) the deviation bar is out of view.
In the event of ILS failure, the deviation bar goes out of view and a red ILS message (3 mm) comes into view above the aircraft symbol.
In all cases, ILS1 (or ILS2) FAULT bits are set to 0 on the output bus.
Vertical deviation :
The scale is white with the scale origin yellow and a magenta mobile index. The index and the scale display the classical glide slope deviation (magenta G/S indication is displayed above the scale). There is a deviation of ± 0.175 ddm (150 μA) between the two extreme dots.
In the event of failure, the index goes out of view. In the place of the scale origin (zero), a red G/S indication (3 mm) is displayed when the ILS mode is selected. ILS1 (or ILS2) FAULT bit is set to status 1.
The ILS indication in ROSE mode and the frequency selected on ILS Control Box are displayed in cyan above the aircraft heading in ROSE mode and under the upper arc in ARC mode. The course value is displayed on the RH side of the upper part of the ND.
In case of no computed data (ILS frequency or course not received) the value is replaced by dashed lines.



-1- VOR/ILS ANNUNCIATOR
IT SIGNIFIES THAT THE NAVIGATION INFORMATION ON THE CRT CORRESPONDS TO ILS MODE OF OPERATION

-2- RUNWAY HEADING ANNUNCIATOR
THIS HEADING ANNUNCIATOR DISPLAYS THE SAME VALUE AS THE RUNWAY COURSE POINTER AND THAT SELECTED ON THE ILS CONTROL BOX.

-3- GLIDE SLOPE INDEX
THIS GREEN INDEX DISPLACES AGAINST THE G/S SCALE. DURING EXCESSIVE GLIDE DEVIATION IT FLASHES AND DISAPPEARS DURING NON-COMPUTED DATA.

-4- G/S FAILURE WARNING MESSAGE
WITH A GLIDE SLOPE FAILURE A RED G/S WARNING MESSAGE APPEARS IN THE CENTRE OF THE G/S SCALE AND THE INDEX DISAPPEARS.

-5- GLIDE SLOPE SCALE
THIS GREEN SCALE APPEARS ONLY IN ILS OPERATION. A TWO-DOT DEVIATION REPRESENTS 0.175 DDM.

-6- LOCALIZER FAILURE WARNING MESSAGE
WITH A LOCALIZER FAILURE, A RED ILS WARNING MESSAGE APPEARS IN THE CENTER OF THE LOC SCALE, AND THE LOCALIZER DEVIATION BAR DISAPPEARS.

-7- LOCALIZER DEVIATION BAR
THIS GREEN DEVIATION BAR DISPLACES AGAINST THE LOC DEVIATION SCALE. IT FLASHES DURING EXCESSIVE LOC DEVIATION, AND DISAPPEARS DURING NON-COMPUTED DATA.

-8- LATERAL DEVIATION SCALE
IN ILS OPERATION, A TWO-DOT DEVIATION REPRESENTS 0.155 DDM.

-9- ILS FREQUENCY ANNUNCIATOR
THIS FREQUENCY ANNUNCIATOR DISPLAYS THE SAME VALUE AS THE SELECTED ON THE ILS CONTROL BOX.

BM5 34 36 00 0 AJR0 01

ND - ILS Mode
Figure 007

B. Utilization

(1)ILS control box

(Ref. Fig. 008)

The ILS control box and data explaining its operation, and the internal architecture of the box are indicated in the figures mentioned above.

Operation :

Rotation of the selector knobs generates pulses enabling microprocessors 1, 2 and 3 to compute selected frequency and runway heading.

- Microprocessors 1 and 2 generate and supply corresponding line transmitter with the required information (frequency, runway heading, labels etc...)
- the line transmitter standardizes the information from the microprocessor to ARINC format.
- The line receiver receives and supplies microprocessor 3 with the information from transmitters 1 and 2.
- Microprocessor 3 checks and displays the information and enables transmission if the information is correct and inhibits transmission if the information is incorrect (blocking of line amplifiers).

(Ref. Fig. 009)

(2)Display control

As indicated in paragraph 4. A. (1) the data displayed on the PFDs can be either VOR, NAV or ILS data. Selection of either mode is made through a mode selector switch (Ref. Fig. 006).

R **ON A/C 001-100,

(3)ILS receiver

The receiver includes :

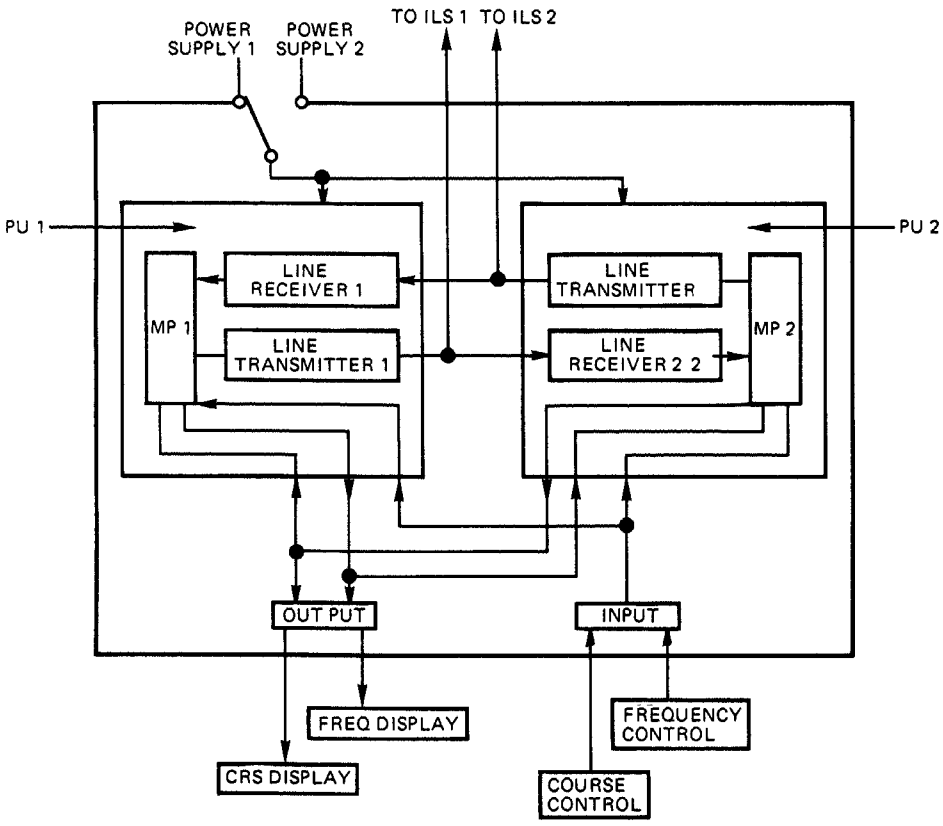
. a LOC tuner
. a GLIDE tuner
. a BITE module
. an ILS module
. a CPU module
. a CPU monitor module
. a DATA interface module

R **ON A/C 101-200,

R (3)ILS receiver
R The receiver includes :
R . a LOC tuner
R . a GLIDE tuner
R . The preprocessor
R . The instrumentation processor and the monitoring processor
R . The input/output unit.

R **ON A/C 001-100,

(Ref. Fig. 010)



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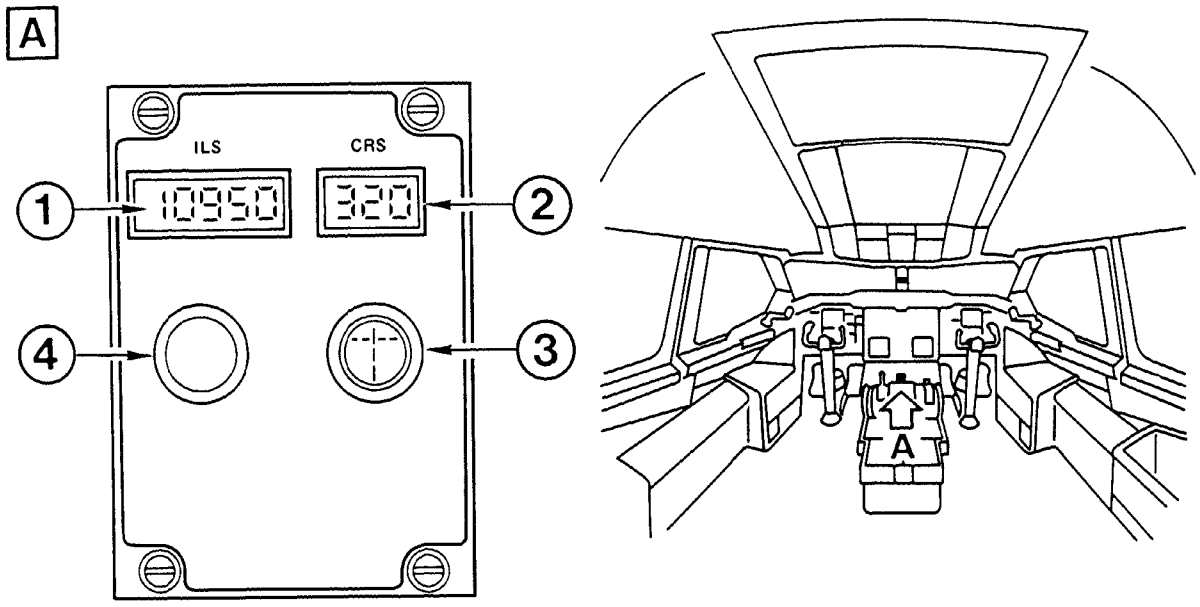
Control Box Architecture
Figure 008



·1· FREQUENCY DISPLAY WINDOW :
IT DISPLAYS SELECTED ILS FREQUENCY FROM 108.10 TO 111.95 MHZ

·2· COURSE DISPLAY WINDOW :
IT DISPLAYS SELECTED RUNWAY COURSE FROM 0 TO 359 DEGREES.

·3· COURSE SELECTOR KNOB .
THE OUTER KNOB CONTROLS AND SELECTS THE RUNWAY COURSE WHICH IS DISPLAYED IN THE COURSE DISPLAY WINDOW. THE INNER PUSHBUTTON KNOB, WHEN PRESSED, CHANGES THE RUNWAY COURSE BY A 180 DEGREES.

·4· FREQUENCY SELECTOR KNOB :
THE OUTER KNOB CONTROLS THE UNITS OF MEGAHERTZ AND THE INNER KNOB CONTROLS THE HUNDREDTHS OF MEGAHERTZ.

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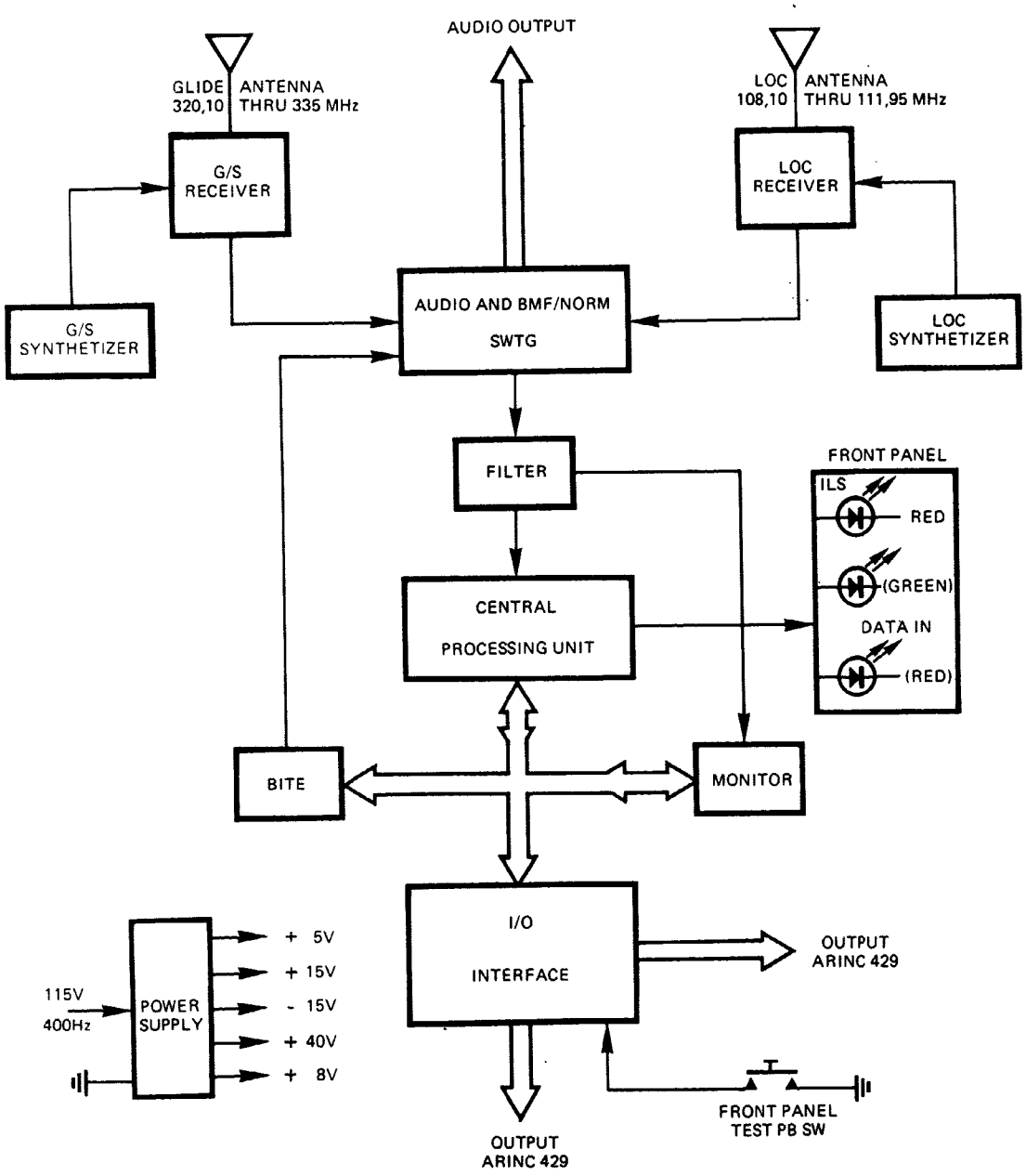
ILS Control Box
Figure 009



BM5 34 36 00 0 AMPO

ILS - Simplified Block Diagram
Figure 010

R **ON A/C 101-200,

R (Ref. Fig. 011)

R **ON A/C 001-100,

(a)LOC tuner
The LOC tuner receives and demodulates the signal from one of the 40 LOC channels ranging from 108.10 to 111.95 MHz with a 50 KHz spacing.
The tuner includes :
1 a preselector : it is tuned to the selected localizer channel by a tuning voltage provided by the CPU module.
2 a mixer -it subtracts the local oscillator frequency from the pre-selector localizer to produce a 18.1 MHz IF signal.
3 two IF amplifiers -the 2nd one is a three stage amplifier.
4 an envelope detector -it detects the low frequency envelope of the received signal.

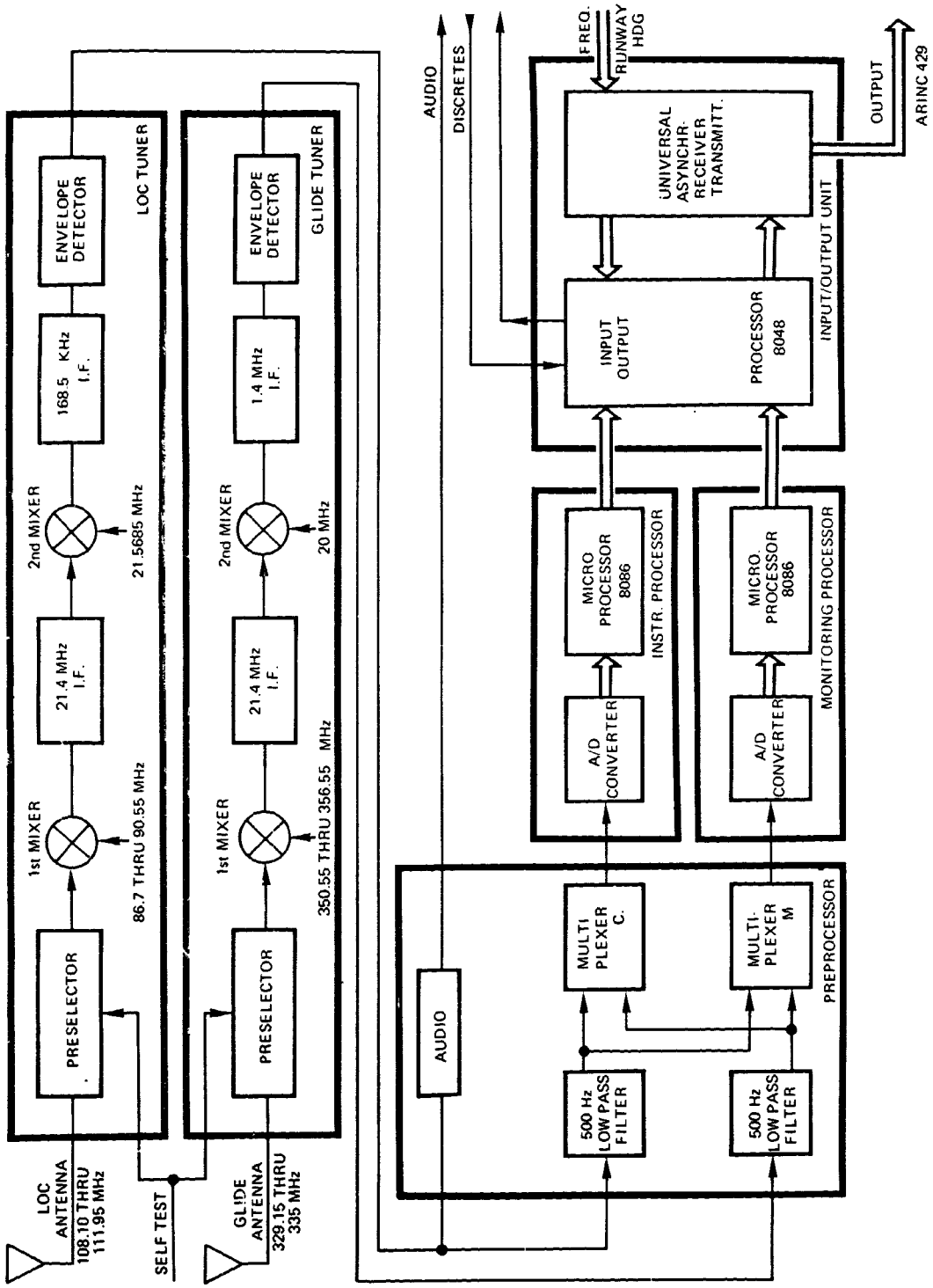
(b)GLIDE tuner
The GLIDE tuner receives and demodulates the signal from one of the 40 channels ranging from 329.15 to 335 MHz with a 150 KHz spacing and coupled with the LOC frequencies (correspondence with these frequencies is defined in the ICAO document, Appandix 10, para. 3.1.5.1).
The tuner includes :
1 a preselector -it is formed by a broadband front-end filter which functions as a fixed tune preselector.
2 a mixer -it subtracts the local oscillator frequency from the pre-selector glide slope signal to produce a 30.2 MHz IF signal.
3 two IF amplifiers -the 2nd one is a three stage amplifier.
4 an envelope detector -it detects the low frequency envelope of the received signal.

(c)BITE module
The BITE module generates ILS 90Hz/150Hz test composite signals during the test sequence. The test composite signals can be applied directly to the ILS module or used to modulate test oscillator signals injected into the localizer and glide slope receiver mixers.
ILS or test composite signals are switched in this module following requirements for processing.

(d)ILS module
It processes the localizer and the glide slope composite signals. Its circuits separate the 90Hz and 150Hz tones from each composite signal and generate a DC voltage proportional to the modulation level of each tone.

(e)CPU module
It performs the primary control, timing, logic and computations required for receiver operation. The major device of this module is the INTEL 8085A microprocessor.

(f)CPU monitor module
It reads the eight analog localizer and glide slope tones from the ILS module, converts the analog voltages to digital format, computes the localizer and glide slope course deviation in DDM and compares its



BM5 34 36 00 0 AMMO

ILS - Simplified Block Diagram
Figure 011

R

R EFFECTIVITY: 101-200,

PIA

computations with the primary CPU computation transmitted on the ARINC 429 data bus.

(g) DATA interface module

The data interface module provides a two-way ARINC 429 communication path between the receiver, the remote control unit and the flight compartment display devices. Separate 32 bit data words that contain localizer and glide slope course deviations data are converted from parallel to serial format by an LSI circuit and transmitted over the ARINC 429 data bus to the flight compartment display devices. Serial receiver tuning data and control discretes are received by the data interface module and processed by a second LSI circuit and other digital interface circuits.

R **ON A/C 101-200,

R (a)LOC tuner
R The LOC tuner receives and demodulates the signal from one of the 40 LOC channels ranging from 108.10 to 111.95 MHz with a 50 KHz spacing.
R The tuner includes :
R 1 a preselector composed of :
R - a first 12 MHz bandwidth, -1.3 dB attenuation preselector
R - a LF amplifier with a gain of +12 dB
R - a second 5 MHz bandwidth, -3.5 dB attenuation preselector.
R The preselectors are tuned by the synthesizer to obtain the IF resonance.
R 2 an intermediate frequency (IF) stage comprising :
R - a first mixer with injection of 86.7 to 90.55 MHz signal controlled by the LOC synthesizer to obtain the first 21.4 MHz intermediate frequency
R - a 21.4 MHz filter with a 30 KHz bandwidth (at 6 dB)
R - a 21.4 MHz amplifier with a gain of +25 dB
R - a second mixer with injection of a 21.5685 MHz signal
R - a 168.5 KHz three-stage amplifier with a gain of 28 + 28 + 26 dB.
R 3 A demodulator which detects the low frequency envelope of the signal received.
R (b)GLIDE tuner
R The GLIDE tuner receives and demodulates the signal from one of the 40 channels ranging from 329.15 to 335 MHz with a 150 KHz spacing and coupled with the LOC frequencies (correspondence with these frequencies is defined in the ICAO document, Appendix 10, para. 3.1.5.1).
R The tuner includes :
R 1 a 10 MHz bandwidth preselector with a -4 dB attenuation
R 2 an intermediate frequency (IF) stage including :
R - a first mixer with injection of a 350.55 to 356.55 MHz signal, controlled by the GLIDE synthesizer to obtain the first 21.4 MHz intermediate frequency
R - a 21.4 MHz filter with a 60 KHz bandwidth (at 6 dB)
R - a 21.4 MHz amplifier with a gain of +25 dB
R - a second mixer with injection of a 20 MHz signal
R - a 1.4 MHz three-stage amplifier with a gain of 28 + 28 + 30 dB.
R 3 A demodulator which detects the low frequency envelope of the signal received.
R (c)Preprocessor
R The signals from the LOC and GLIDE tuners are multiplexed and their bandwidth is limited for preparation of digitizing.
R The LOC signal is also filtered and amplified for the audio signal.
R (d)Instrumentation processor (and monitoring processor)
R The instrumentation processor includes an analog-to-digital converter and an INTEL 8086 16-bit microprocessor.
R The LOC and GLIDE deviations and the signal level are extracted from the composite signal.
R To these outputs are applied corrections which are computed and stored in memory in the following configurations :

R . during a self-test
R . when applying power
R . when changing the channel.
R During the self-test, preponderant and known 90 Hz and 150 Hz signals
R are generated sequentially. The error at channel output is stored in
R memory and used for correction of the outputs.

R **ON A/C ALL

C. Tests
When ILS1 or ILS2 test pushbutton switch is held pressed, the following sequence is carried out :

DURATION	PFD and ND
Approx. 5 s	LOC and G/S failure warning messages
Approx. 3 s	LOC index/deviation bar : 1 dot to the left G/S index : 1 dot upwards
Approx. 2 s	Transition from left to right and up to down
Until test pushbutton switch is released or until end of test (total deviation 16s)	LOC index/deviation bar : 1 dot to the right G/S index : 1 dot downwards

D. Outputs
The two control box inputs (selected frequency and selected runway heading) are converted into digital form and transmitted on the output data bus lines.
Additionally, the receiver outputs include LOC and GLIDE deviation.

**ON A/C 001-003,

(Ref. Fig. 012)

R **ON A/C 004-200,

(Ref. Fig. 013)

**ON A/C ALL

E. Face of ILS Receiver

R **ON A/C 001-100,

(Ref. Fig. 014)

R **ON A/C 101-200,

R (Ref. Fig. 015)

R **ON A/C 001-100,

The face of the ILS receiver is shown with associated indications.
-1- ILS fail LED :
ILS red LED on if an internal fault is detected.

-2- ILS pass LED :
ILS green LED on if no internal fault is detected.

-3- DATA IN fail LED :
DATA IN red LED on if no control input is available or if input is in incorrect ARINC 429 format.

-4- TEST pushbutton switch :
When pressed and held for 10 seconds, the three LEDs come on for three seconds, then go off for three to six seconds. According to test result one or two LEDs come on and remain on until the pushbutton switch is released.

R **ON A/C 101-200,

R The face of the ILS receiver is shown with associated indications.
R -1- CONTROL INPUT FAIL indicator :

INTENTIONALLY BLANK

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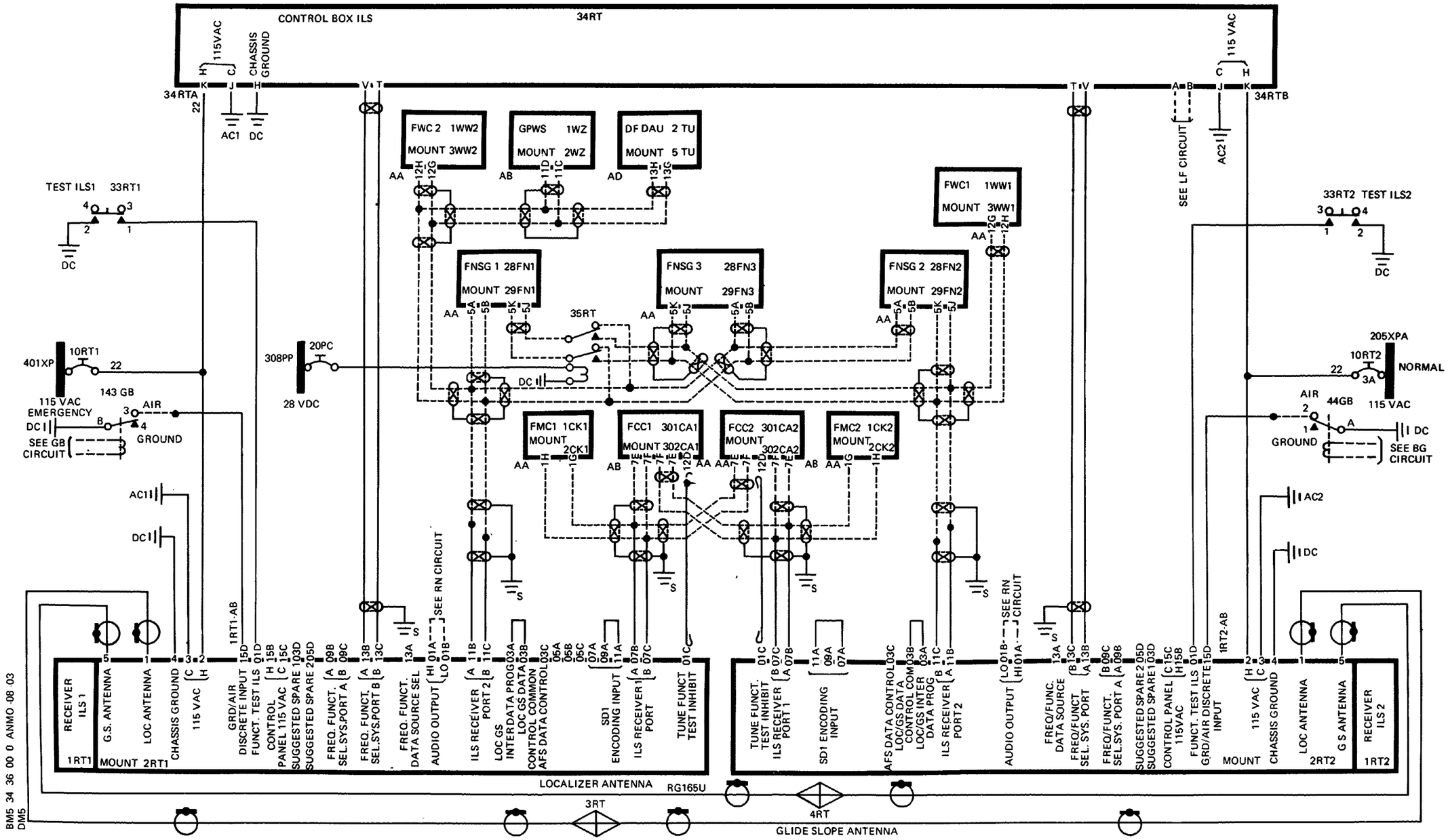
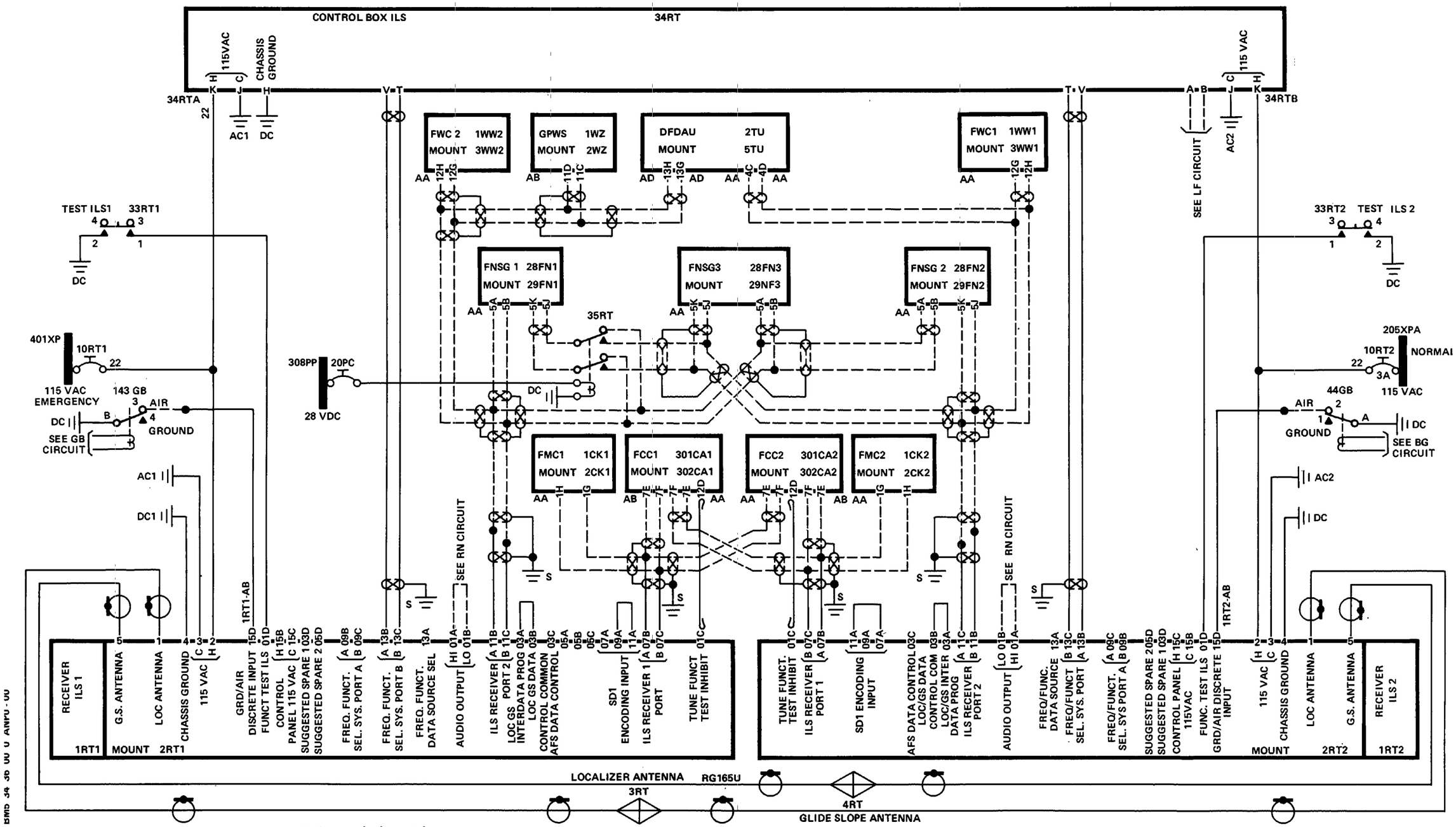
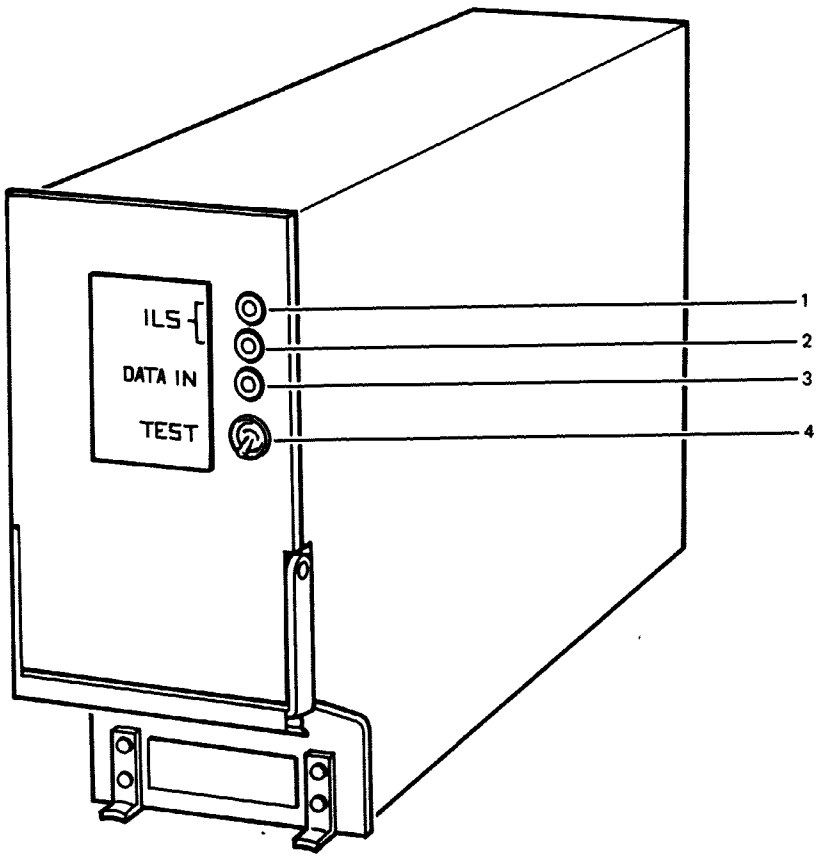


ILS - Wiring Diagram
Figure 012

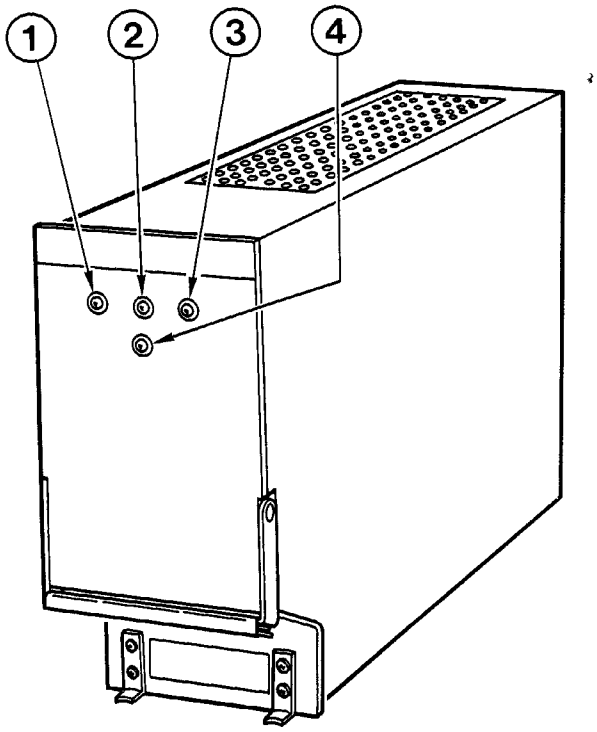


ILS - Wiring Diagram
Figure 013



BM5 34 36 00 0 APPO

ILS Receiver - Face
Figure 014



ILS RECEIVER

BM5 34 36 00 0 APM0 - 00

R

ILS Receiver - Face
Figure 015

R It illuminates red when no control input is available from the control
R box.

R -2- **LRU STATUS PASS** indicator :
R It illuminates green, when no fault is detected during the test sequence

R -3- **LRU STATUS FAIL** indicator :
R It illuminates red, when a fault is detected during the test sequence

R -4- **TEST** pushbutton switch :
R When pressed and held for 10 seconds, the three indicators come on for
R three seconds, then go off for three to six seconds. According to test
R results, one or two **LEDS** come on and remain on until the pushbutton switch
R is released.

1. Operational Test

A. Reason for the Job
Check of ILS data displays.

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
- 21-21-00, P. Block 501	Flight Compartment and Electronics Racks Air Distribution
- 24-41-00, P. Block 301	AC External Power Control
- 31-51-00, P. Block 1	ECAM System
- 34-25-00, P. Block 501	Inertial Reference System
- 34-70-00, P. Block 1	EFIS

C. Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(1)Job Set-Up

- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION and ECAM.
- Make certain that EFIS is operating and adjust PFD and ND image brightness on panels 412VU and 413VU.
- Make certain that ECAM is operating and adjust left ECAM display unit image brightness with LEFT DISPLAY knob on center pedestal.
- Align the IRS
- On Captain and First Officer EFIS control panels place mode selector switch in ROSE or ARC position.
- Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (Aircraft in ground configuration).
- On ECAM control panel press CLR pushbutton switch until MASTER WARN and MASTER CAUTION lights, on panel 3VU and 5VU, are off and MEMO page appears on left ECAM display unit.

(2)Tests

ACTION	RESULT
1. On CAPT and F/O complementary control panels - select ILS mode	On NDs - ROSE mode : cyan ILS message and frequency appear above A/C heading and magenta G/S message above vertical deviation scale. - ARC mode : cyan ILS message and frequency appear below A/C hea-

ACTION	RESULT
	ding and magenta G/S message above vertical deviation scale.
2. On ILS control box - select course of 0°	On NDS - CRS 000° is displayed on upper right hand corner - selected course pointer indicates 0°.
- select frequency of 109.50 MHZ	On NDs - 109.50 is displayed below the ILS message.
3. On maintenance panel 47OVU R - press and hold ILS1 pushbutton switch	Check that : - for 3 seconds approximately . on CAPT PFD * G/S index is cleared * red G/S failure warning message is displayed above the vertical deviation scale * LOC index is cleared * red LOC failure warning message is displayed in the middle of lateral deviation scale. . on F/O ND (ROSE or ARC mode) * G/S message is cleared * G/S index is cleared * red G/S failure warning message is displayed in the center of vertical deviation scale * LOC deviation bar is cleared * red LOC failure warning message is displayed in the middle of lateral scale. - transitory appearance - on instrument panels of MASTER CAUTION lights . on left ECAM display unit : of NAV ADC ILS1 (ILS2) FAULT . single chime sounds - for the next 3 seconds approximately . on CAPT PFD * G/S index reappears 1 dot up * LOC index reappears 1 dot left . On F/O ND

ACTION	RESULT
	* G/S message reappears above vertical deviation scale * G/S index reappears 1 dot up * LOC deviation bar reappears 1 dot left - for the next 2 seconds approximately . G/S indexes move 1 dot down . LOC index and deviation bar move 1 dot right - until the test is completed (total duration : 16 seconds) or until TEST pushbutton switch is released, whichever comes first. . G/S indexes remain 1 dot down . LOC index and deviation bar remain 1 dot right - then initial display before test comes back.
4. On maintenance panel 47OVU - initiate ILS2 BITE test	Same sequence as steps 2 and 3 except that display is on F/O PFD and CAPT ND.

R

D. Close-up
(1)De-energize EFIS, ECAM and IRS.
(2)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(3)Restore system and aircraft to normal operating conditions.

2. Functional Test

A. Reason for the Job
To ensure correct operation of the aircraft ILS.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	VOR/ILS Ground Test Unit
(2)	Headset 600Ω
Referenced Procedures	
- 21-21-00, P. Block 501	Flight Compartment and Electronics Racks Air Distribution
- 24-41-00, P. Block 301	AC External Power Control
- 31-51-00, P. Block 1	ECAM System
- 34-25-00, P. Block 501	Inertial Reference System
- 34-70-00, P. Block 1	EFIS

C. Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(1)Job set-up
- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION and ECAM.
- Make certain that EFIS is operating and adjust PFD and ND image brightness on panels 412VU and 413VU.
- Make certain that ECAM is operating and adjust left ECAM display unit image brightness with LEFT DISPLAY knob on center pedestal.
- Align the IRS
- On Captain and First Officer EFIS control panels place mode selector switch in ROSE or ARC position.
- Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (Aircraft in ground configuration).
- On ECAM control panel press CLR pushbutton switch until MASTER WARN and MASTER CAUTION light, on panel 3VU and 5VU, are off and MEMO page appears on left ECAM display unit.
- Position VOR/ILS ground test unit.

(2)Tests

(a)Data display test
Repeat Operational test.

(b)Test of ILS reception

NOTE : This test is valid for ILS1, for ILS2 read information in parentheses.

ACTION	RESULT
On ground test unit	
1. Switch on power with G/S and LOC	On CAPT (F/O) PFD

ACTION	RESULT
switches held in OFF position	- G/S and LOC indexes are cleared. On F/O (CAPT) ND in ROSE or ARC mode. - magenta G/S remains displayed above vertical deviation scale until test is completed - G/S index is cleared - LOC deviation bar is cleared.
2. Release G/S and LOC switches and place G/S selector switch in FLY UP/2.0 db and 3.76 db position respectively.	On CAPT (F/O) PFD and F/O (CAPT) ND - G/S indexes move one dot and two dots up respectively.
3. Place G/S selector switch in FLY DOWN/2.0 db and 3.76 db position respectively.	On CAPT /F/O) PFD and F/O (CAPT) ND - G/S indexes move one dot and two dots down respectively.
4. Place G/S selector switch in 0 db position.	On CAPT (F/O) PFD and F/O (CAPT) ND - G/S indexes are centered.
5. Place LOC selector switch in FLY LEFT/0.9 db, 4.0 db and 6.6 db position respectively.	On CAPT (F/O) PFD - LOC index moves a quarter dot, one dot and two dots left respectively. On F/O (CAPT) ND - LOC deviation bar moves a quarter dot, one dot and two dots left respectively.
6. Place LOC selector switch in FLY RIGHT/0.9 db, 4.0 db and 6.6 db position respectively.	On CAPT (F/O) PFD - LOC index moves a quarter dot, one dot and two dots right respectively. On F/O (CAPT) ND - LOC deviation bar moves a quarter dot one dot and two dots right respectively.
7. Place LOC selector switch in 0 db position.	On CAPT (F/O) PFD - LOC index is centered. On F/O (CAPT) ND - LOC deviation bar is centered.
8. On ILS control box 34RT Turn CRS selector knob to 10° then to 350° respectively.	On F/O (CAPT) ND - selected course pointer moves to 10° and to 350° - CRS 010a and CRS 350° are dis-

ACTION	RESULT
	played respectively on upper right corner.

(c)Test of ILS identification

ACTION	RESULT
1. On ground test unit - place and hold IDENT switch in ON position On each audio control panel - set to identification function - disengage and adjust ILS volume knob to give desired audio level	At each interphone station - identification signal can be heard in headset - no crackling during adjustment.
2. On ground test unit - release IDENT switch	Identification signal is no longer heard.

(3)Close-up
(a)De-energize IRS, ECAM and EFIS.
(b)Set ILS volume potentiometer to zero and engage it on audio control panel.
(c)Switch off ground test unit.
(d)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(e)Restore system and aircraft to normal operating conditions.

LOCALIZER 1 AND 2 ANTENNA (3RT) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 3.70 m (12 ft. 1 in.)
B. Material No. 09-015	Sealants (Ref. 20-31-00)
C.	Circuit Breaker Safety Clips
D.	Warning Notices
E.	Blanking Caps
F.	Electrical Ground Power Unit - 3-Phase, 115/200V, 400Hz, 90KVA
G.	600 Ω Headset
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

2. Procedure

WARNING : PLACE ON CENTER PEDESTAL IN FLIGHT COMPARTMENT A WARNING NOTICE PROHIBITING OPERATION OR START-UP OF THE WEATHER RADAR SYSTEM.

A. Job Set-Up

(1) Position access platform below radome.

(2) Open radome.

NOTE : Two men are required to open and close the radome.

(3) Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ILS 1	1ORT1	107/C 3
21VU	RADIO NAV & COM/ILS 2	1ORT2	107/C12

B. Removal

(1) Disconnect the two coaxial connectors (3).

(2) Install blanking caps on the two connectors (3) and receptacles (4) of localizer antenna (1).

(3) Loosen the four screws (5) of mounting plate (2).

(4) Repeat same operation for the second mounting plate.

(5) Remove localizer antenna (1).

C. Installation

(1) Clean and inspect localizer antenna interface and/or adjacent area.

(2) Remove blanking caps from receptacles (4) of localizer antenna and from coaxial connectors (3).

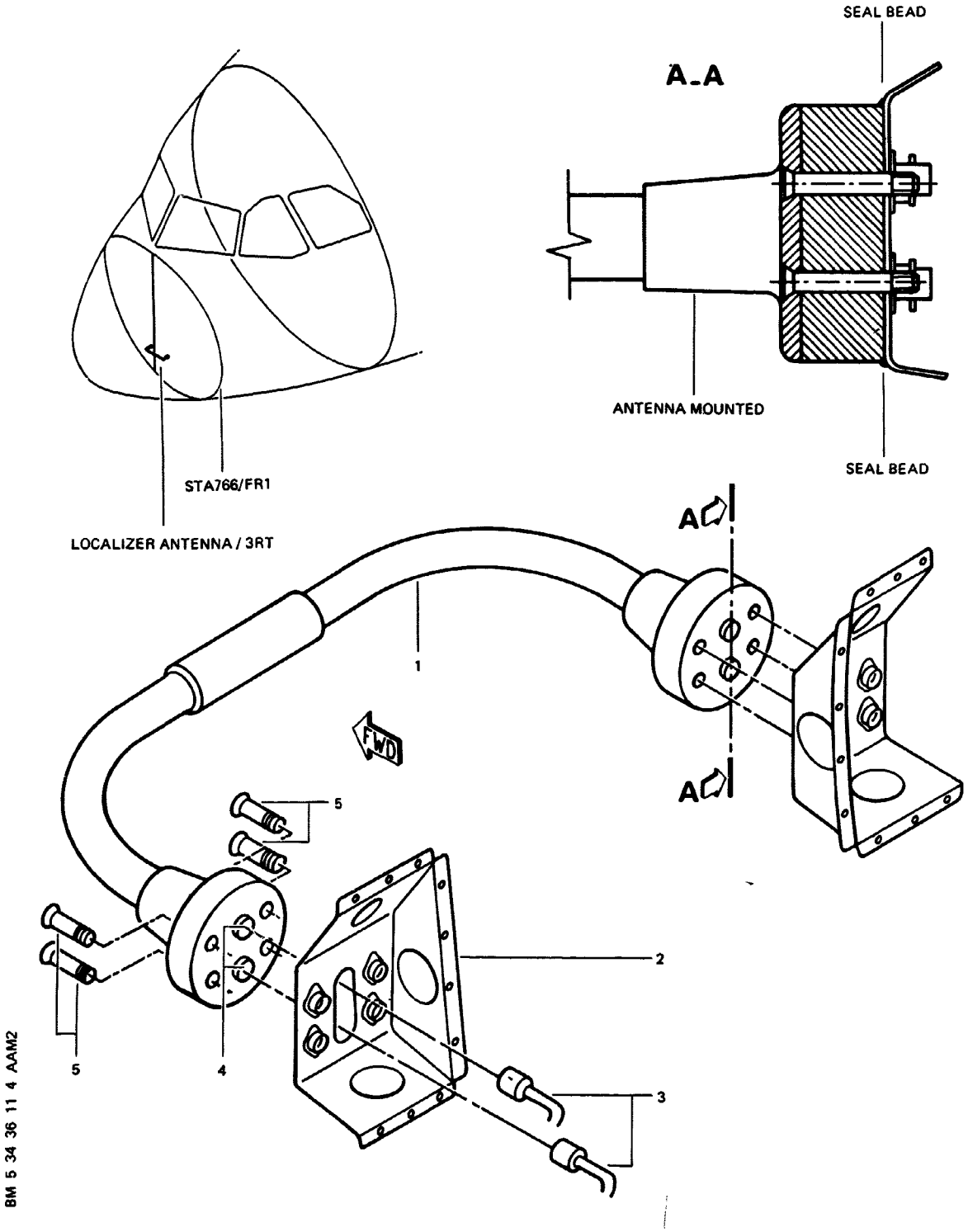
(3) Position antenna (1) on the two mounting plates (2).

(4) Install mounting screws (4), screw in and tighten.

(5) Connect the two coaxial connectors (3) to antenna (1).

(6) Apply Material No.09-015 to antenna (1) base in order to make a seal bead.

(7) Remove safety clips and tags and close circuit breakers 1ORT1 and 1ORT2.



Localizer 1 and 2 Antenna
Figure 401

D. Test
Initial Conditions
- Correct electrical power supply
- Forward services ventilation system in operation
- Overhead panel circuit breakers closed particularly those associated with **NAVIGATION** and **RADIO-NAV & COM.**

ACTION	RESULT
1. On ILS control box - Select a localizer frequency (between 108.1 MHz and 111.9 MHz) for which an ILS signal is received.	
2. On Captain Audio control panel, - Select ILS function and set the other reception channels to minimum level.	Check that the ILS audio signal is heard in headset connected to Captain's jack box.

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Remove the warning notice prohibiting use of weather radar from center pedestal.
(3)Close radome.
(4)Remove access platform.
(5)De-energize aircraft electrical network and disconnect electrical ground power unit.

ILS CONTROL BOX (34RT) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-25-00, P. Block 501	Inertial Reference System
R - 34-70-00, P. Block 1	Electronic Instrument Display

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ILS 1	1ORT1	107/C 3
21VU	RADIO NAV & COM/ILS 2	1ORT2	107/C12
132VU	LIGHTING/INTEGRAL LT/CB & OVHD & PED	3LF	322/N77

B. Removal

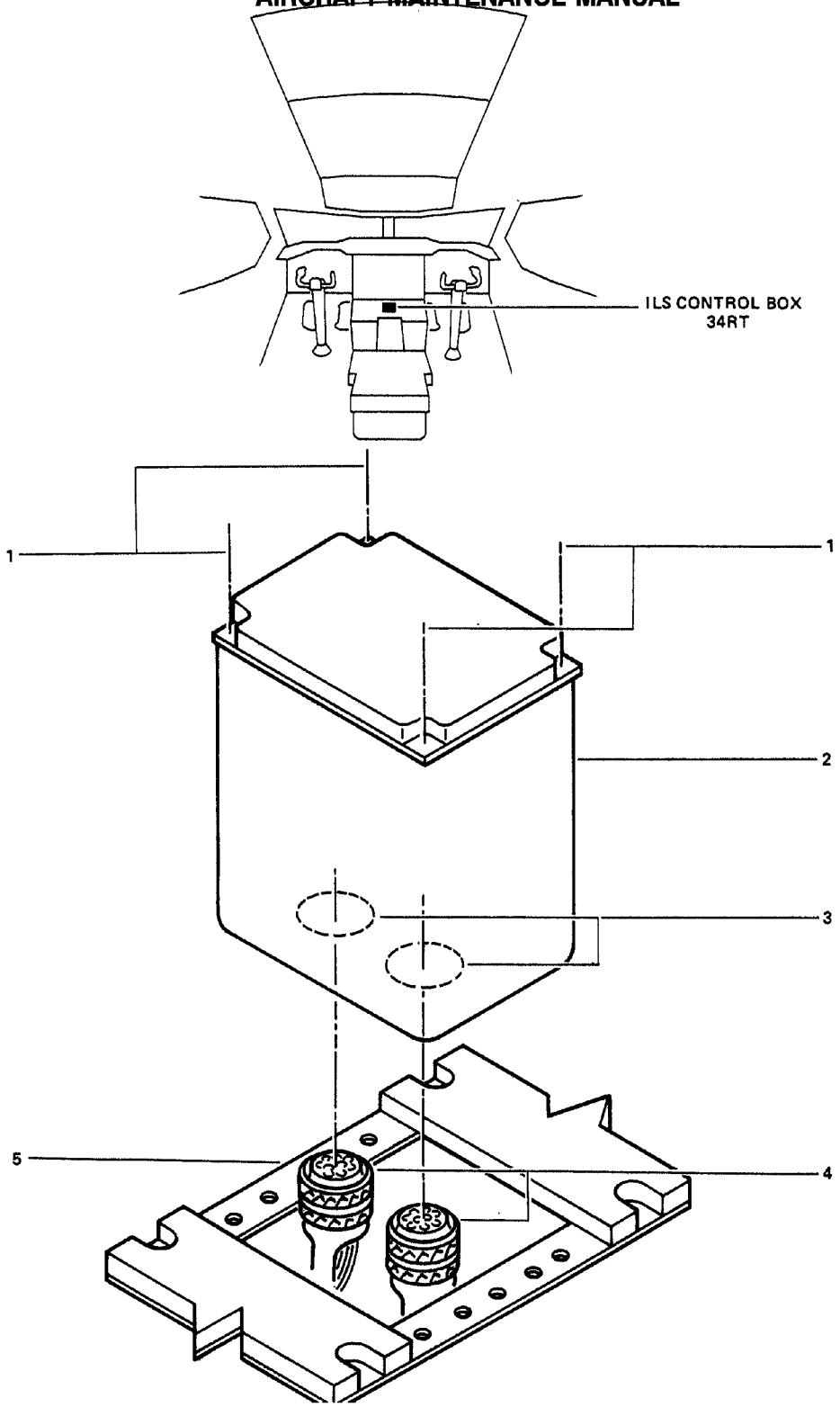
(1)Turn-to-release the four Dzus fasteners (1).
(2)Withdraw ILS control box (2) from its housing.
(3)Disconnect electrical connectors (4).
(4)Cap electrical connectors (3) and (4).
(5)Remove ILS control box (2).

C. Installation

(1)Clean and inspect ILS control box interface and/or adjacent area.
(2)Remove caps from electrical connectors (3) and (4) and perform visual check of pins.
(3)Connect electrical connectors (4) and (3).
(4)Install control box (2) in housing (5).
(5)Turn-to-lock the 4 Dzus fasteners (1).
(6)Remove safety clips and tags and close circuit breakers 1ORT1, 1ORT2 and 3LF.

D. Test

Initial conditions
- correct electrical power supply
- forward services ventilation system in operation
- overhead panel circuit breakers closed
- IRS aligned
- EFIS energized
- ROSE mode selected on EFIS control panels



ILS Control Box
Figure 401

ACTION	RESULT
On complementary navigation control panels : - select ILS mode	On NDs : - ILS message is displayed on the upper half
On ILS control unit : - select 000° course value	- CRS 000 is displayed on upper right hand corner - selected course pointer indicates 0°
- select 180° course value	- CRS 180 is displayed on upper right hand corner - selected course pointer indicates 180°

E. Close-Up
(1)De-energize the EFIS and the IRS.
(2)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(3)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-36-00, P. Block 501	ILS

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/ILS1	10RT1	107/C 3
21VU	RADIO-NAV & COM/ILS2	10RT2	107/C12

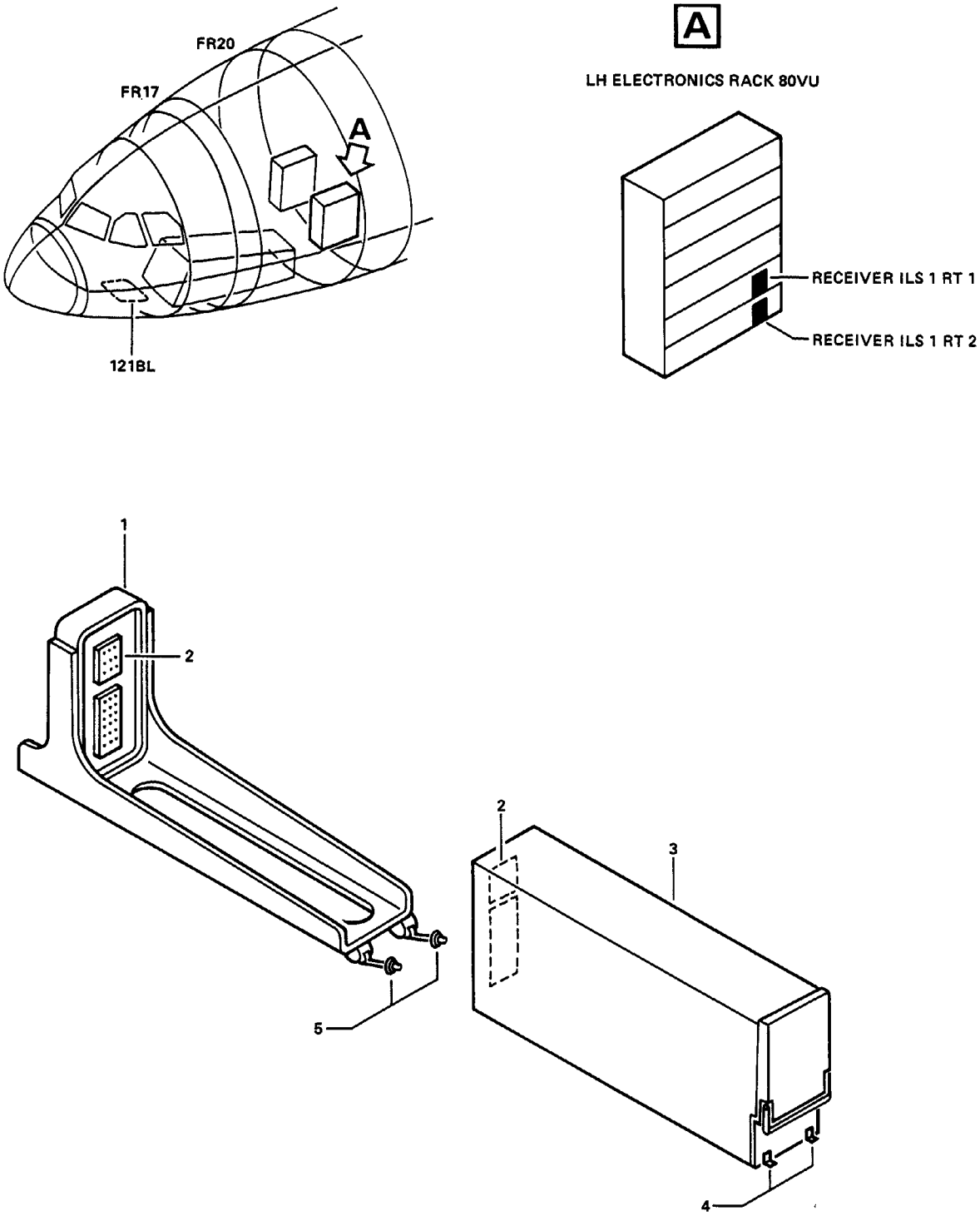
(2)Open access door 121BL and gain access to ILS receiver to be removed.

B. Removal
(1)Unscrew knurled retaining nuts (5) located at front of mount (1) and swing them downwards.
(2)Withdraw ILS receiver (3) from mount (1) taking care not to damage the electrical connectors (2).
(3)Cap electrical connectors (2).
(4)Remove ILS receiver (3).

C. Installation
(1)Clean and inspect ILS receiver (3) interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (2).
(3)Check electrical connectors (2) for correct condition.
(4)Carefully slide ILS receiver (3) into position on mount (1).
(5)Engage knurled retaining nuts (5) in studs (4) and tighten.
(6)Remove safety clips and tags and close circuit breakers 10RT1 and 10RT2.

D. Test
Carry out operational test of ILS (Ref. 34-36-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.



ILS Receiver - Removal/Installation
Figure 401

GLIDE ANTENNA (4RT) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.20 m (7 ft. 3 in.)
B.	Circuit Breaker Safety Clips
C.	Blanking Caps
D. Material No. 09-015	Sealants (Ref. 20-31-00)
E.	VOR/ILS Ground Test Unit
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(Ref. Fig. 401)

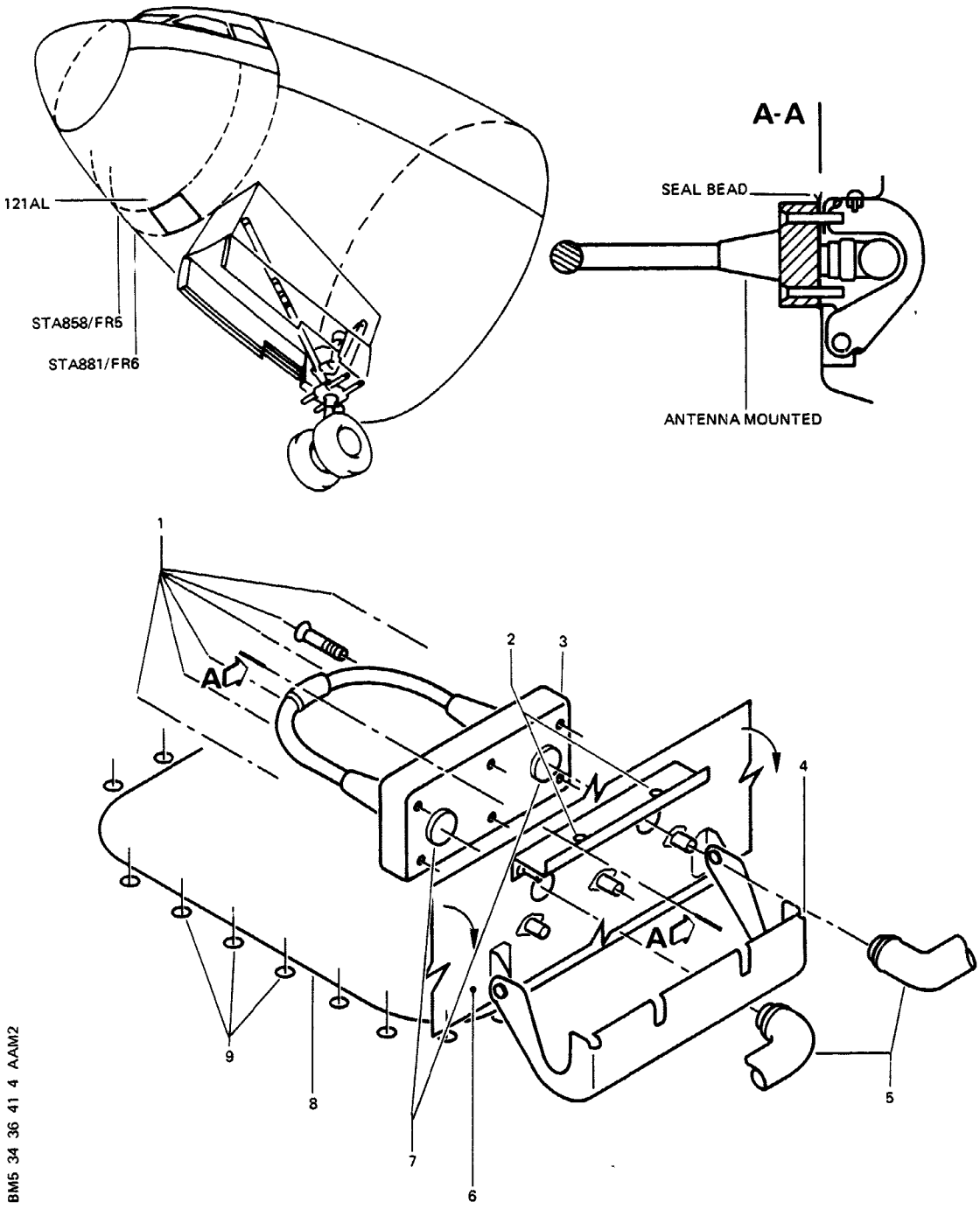
2. Procedure

A. Job Set-Up
(1)Position access platform below access door 121AL (8).
(2)Loosen screws (9) on access door 121AL (8).
(3)Remove access door (8).
(4)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV AND COM/ILS1	1ORT1	107/C 3
21VU	RADIO NAV AND COM/ILS2	1ORT2	107/C12

B. Removal
(1)Unscrew without removing the two attaching screws (2) from protective casing (4).
(2)Fold down protective casing (4).
(3)Disconnect and cap the two coaxial connectors (5).
(4)Cap receptacles (7) on antenna (3).
(5)Remove the six mounting screws (1) from antenna (3).
(6)Remove antenna (3).

C. Installation
(1)Clean and inspect antenna interface and/or adjacent area.
(2)Position antenna (3) on its mounting plate (6).
(3)Install the six mounting screws (1), screw and tighten.
(4)Remove blanking caps from the two coaxial connectors (5) and antenna (3) receptacles (7). Check condition of coaxial cables.
(5)Connect the two coaxial connectors (5) to antenna (3).
(6)Close protective casing (4).
(7)Tighten the 2 screws (2) on protective casing (4).
(8)Apply sealant material 09-015 on antenna (3) base in order to make a seal bead.
(9)Remove safety clips and tags and close cicuit breakers 1ORT1 and 1ORT2.



Glide Antenna
Figure 401

D. Test

Initial conditions

- Correct electrical power supply.
- Forward services ventilation system in operation.
- Overhead panel circuit breakers closed, particularly those associated with **NAVIGATION** and **RADIO NAV & COM.**
- Rose mode selected on **EFIS** Control Panels **(CAPT & F/O).**
- Install a **VOR/ILS** ground test unit.
- Connect **LOCALIZER** and **GLIDE SLOPE** antennas to corresponding connectors (antennas project outside the aircraft through a side window).
- Select **ILS** function.
- On **ILS** Control **Box,** set a local frequency corresponding to signal emitted by ground test unit.

ACTION	RESULT
On ground test unit :	
1. Place **GLIDE SLOPE DDM** switch in 0 ddm position.	- On **CAPT** instrument panel **G/S** index appears centered on **ND.** - On **F/O** instrument panel **G/S** index appears centered on **PFD.**
2. Place **GLIDE SLOPE DDM** switch in **FLY-UP 0.175** ddm position.	- On **CAPT** instrument panel **G/S** index goes two dots up on **ND.** - On **F/O** instrument panel **G/S** index goes two dots up on **PFD.**

E. Close-up

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Install access door 121AL (8). Secure door by means of screws (9).
(3)Remove access platform.
(4)De-energize the aircraft electrical network. (Ref. 24-41-00, P. Block 301).
(5)Switch off and remove **VOR/ILS** ground test unit.
(6)Restore system and aircraft to normal operating condition.

1. General
(Ref. Fig. 001)
The Weather Radar System is a commercial X-band radar comprising an antenna (consisting of a pedestal and a flat plate planar array), a transceiver and a control box. The system is used in conjunction with the Electronic Flight Instrument System (EFIS) to display the weather picture on the Navigation Display at both the pilot's and first officer's stations.
The operational principle is based on the reflective effect of vertically polarized microwave radiation on material substances. Microwave pulses, generated by a transceiver, are emitted through a directive antenna to illuminate targets ahead of the aircraft. The reflected echo is picked up by the same antenna and amplified as well as processed by the transceiver. After final arrangement by the EFIS Symbol Generator Unit (SGU), the echo is displayed on the Navigation Display.
The Navigation Display is a colored visual display of precipitation levels for ranges up to 240 miles in front and 60 degrees on either side of the aicraft's principal axis. The transmitted radar beam can be deflected in elevation 15 degrees above or below the aircraft's principal axis by a manual tilt control. The radar controls are located on the radar control box and the EFIS Control Panel.
Besides the weather information the radar provides the crew with a colored visual display of turbulent areas related to precipitation. Moderate or high turbulences may be indicated up to a range of 40 nautical miles.

2. Component Location
(Ref. Fig. 002)

R **ON A/C 001-100,

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF
1SQ1	TRANSCEIVER-WEATHER RADAR	115VU	121		34-41-33
1SQ2	TRANSCEIVER-WEATHER RADAR	115VU	121		34-41-33
3SQ	CONTROL BOX RADAR	11VU	210		34-41-12
4SQ	ANTENNA-WEATHER RADAR FLAT PLATE		110		34-41-11
11SQ	SHOCKMOUNT-WEATHER RADAR TRANSCEIVER	115VU	121		
14SQ	WAVE GUIDE ASSY	115VU	121/110		
28SQ	ANTENNA, WEATHER RADAR, DUAL DRIVE		110		
29SQ	RESISTOR	87VU	121		
30SQ	RESISTOR	87VU	121		
31SQ	RESISTOR	87VU	121		
32SQ	RESISTOR	87VU	121		

R **ON A/C 101-200,

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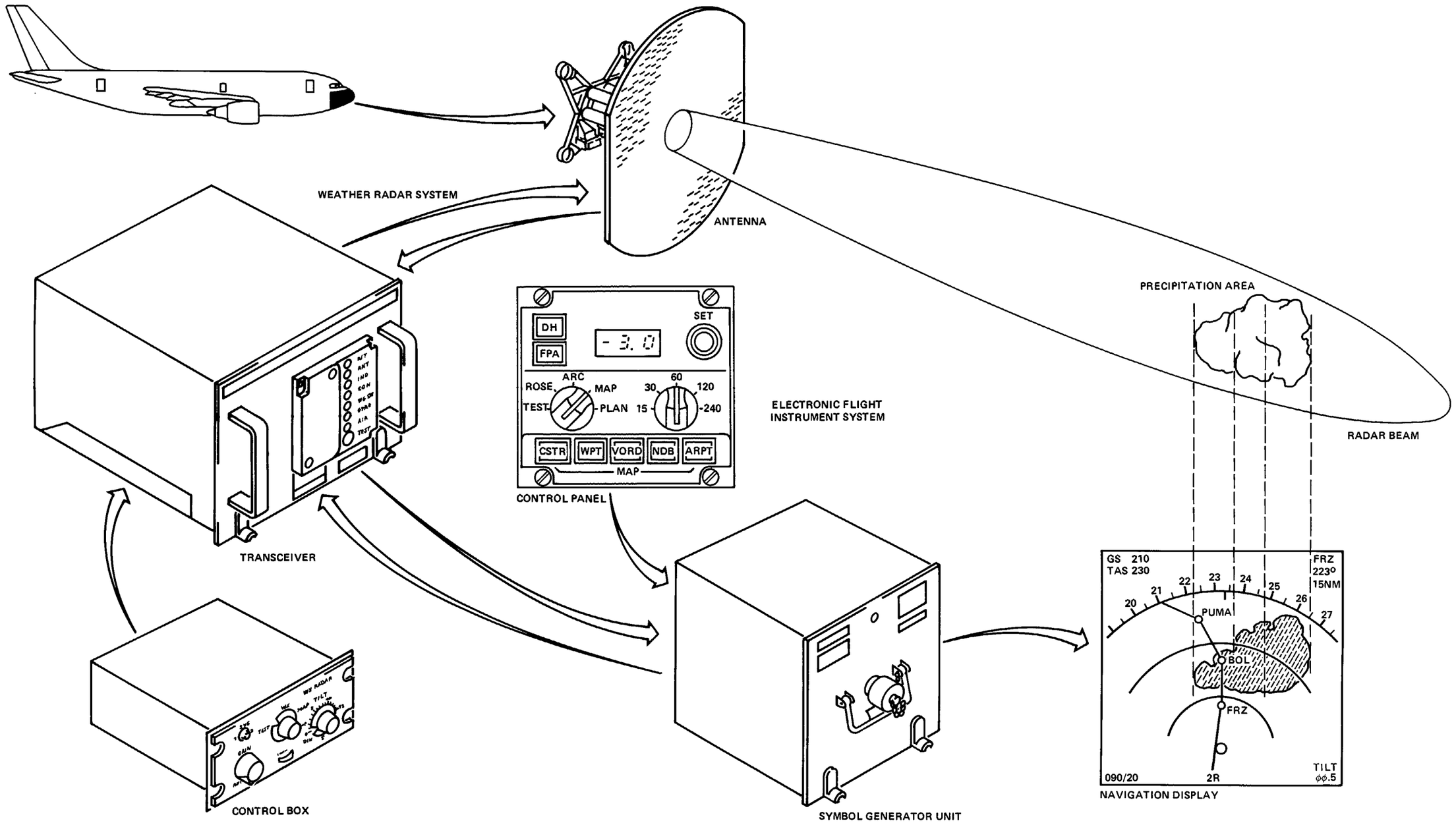

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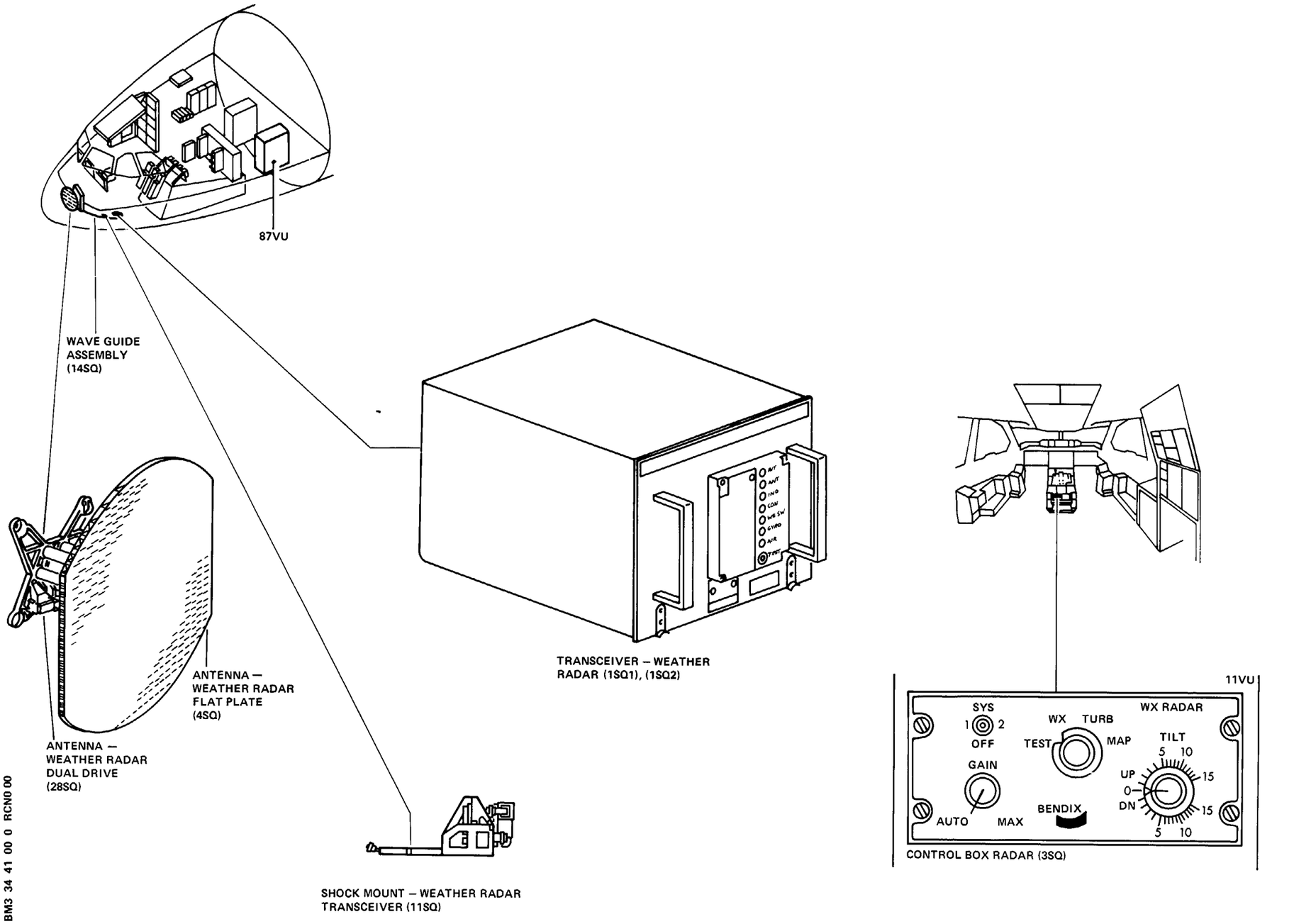
Weather Radar Principle
Figure 001



BM3 34 41 00 0 RCN0 00

Weather Radar - Component Location
Figure 002

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF
1SQ1	TRANSCEIVER-WEATHER RADAR	115VU	121		34-41-33
3SQ	CONTROL BOX RADAR	11VU	210		34-41-12
4SQ	ANTENNA-WEATHER RADAR FLAT PLATE		110		34-41-11
11SQ	SHOCKMOUNT-WEATHER RADAR TRANSCEIVER	115VU	121		
14SQ	WAVE GUIDE ASSY	115VU	121/110		
28SQ	ANTENNA, WEATHER RADAR, DUAL DRIVE		110		
29SQ	RESISTOR	87VU	121		
30SQ	RESISTOR	87VU	121		
31SQ	RESISTOR	87VU	121		
32SQ	RESISTOR	87VU	121		

R **ON A/C ALL

3. System Description

R **ON A/C 001-100,

(Ref. Fig. 003)

R **ON A/C 101-200,

R (Ref. Fig. 004)

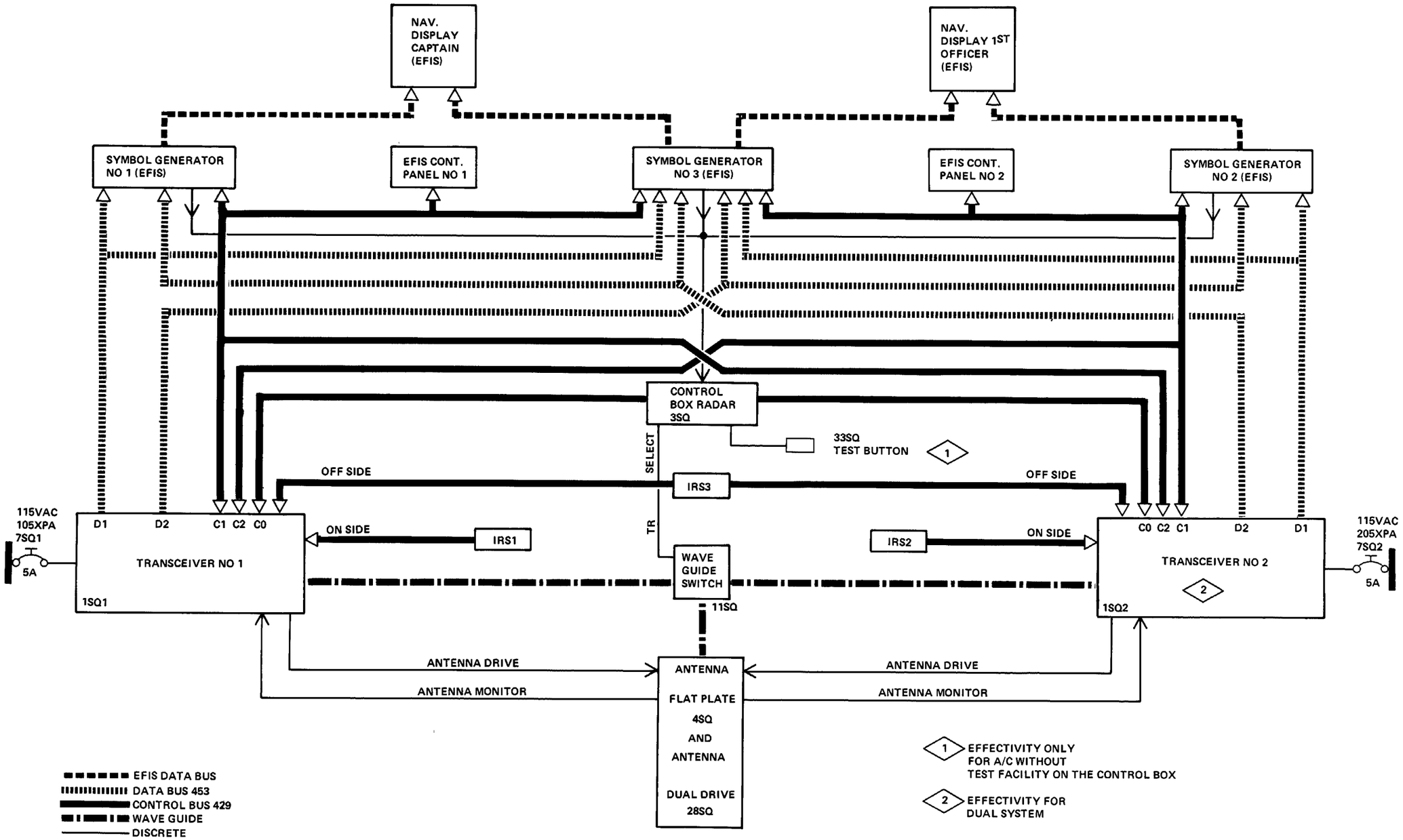
R **ON A/C ALL

(Ref. Fig. 005)

R **ON A/C 001-100,

A. Weather Radar System Components
The Weather Radar System is designed for single or dual system operation and consists of the following components:
(1) Weather Radar Transceiver (1SQ1), used for transmission of X-band radio frequency (RF) pulses and processing of the received echo returns as well as for the generation of system power antenna drive signals and various control signals.
In dual system configurations a second transceiver (1SQ2) is integrated. Both transceivers may be selected alternatively.
(2) Radar Control Box (3SQ), used for various control functions of the transceiver in a single or dual system.
(3) Antenna - Weather Radar Dual Drive (28SQ), used as carrier for antenna drive and antenna flat plate planar array and provided with mounting surfaces. Full provision is made for use in a dual system.
(4) Antenna - Weather Radar Flat Plate Planar Array (4SQ), used for radiation of RF pulses and reception of associated echo returns.
(5) Dual Shockmount - Weather Radar Transceiver (11SQ), used for the installation of the transceiver. Full provision for the installation of a second transceiver is made by dual connections and a waveguide change-over switch.
(6) Waveguide Assembly (14SQ), used as RF transmission line between transceiver and antenna.
(7) Circuit Breakers (7SQ1,7SQ2), apply main power to the transceivers.
NOTE : Circuit Breaker 7SQ2 is only operational in dual systems.
(8) Resistors (29SQ,30SQ,31SQ,32SQ), used as terminations for the data bus lines between the transceiver and the Symbol Generator Units (SGU) of the EFIS.

R **ON A/C 101-200,



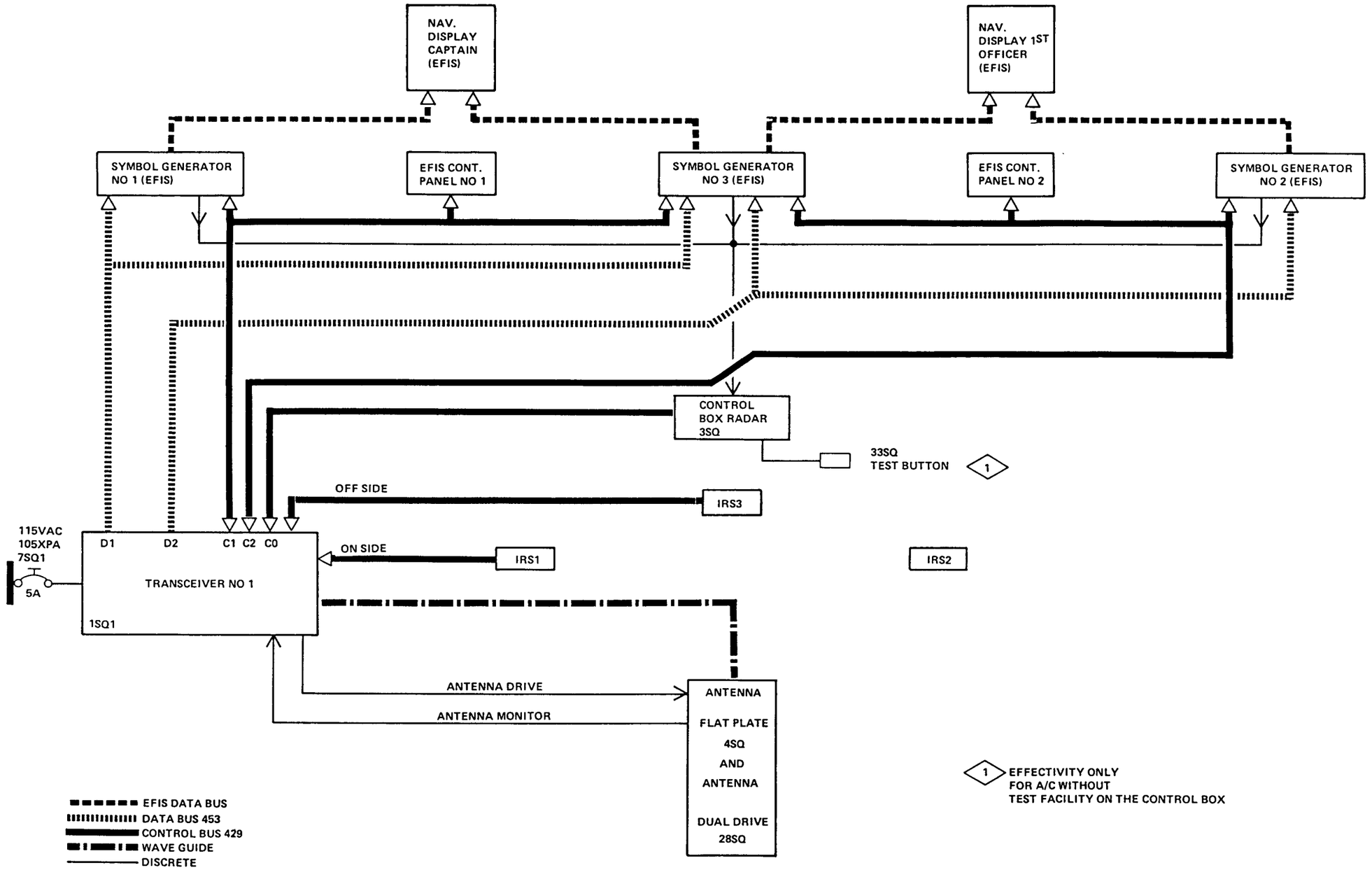
BM3 34 41 00 0 RCM0 00

Block Diagram - Weather Radar
Figure 003

R EFFECTIVITY: 001-100,

PIA

Printed in France



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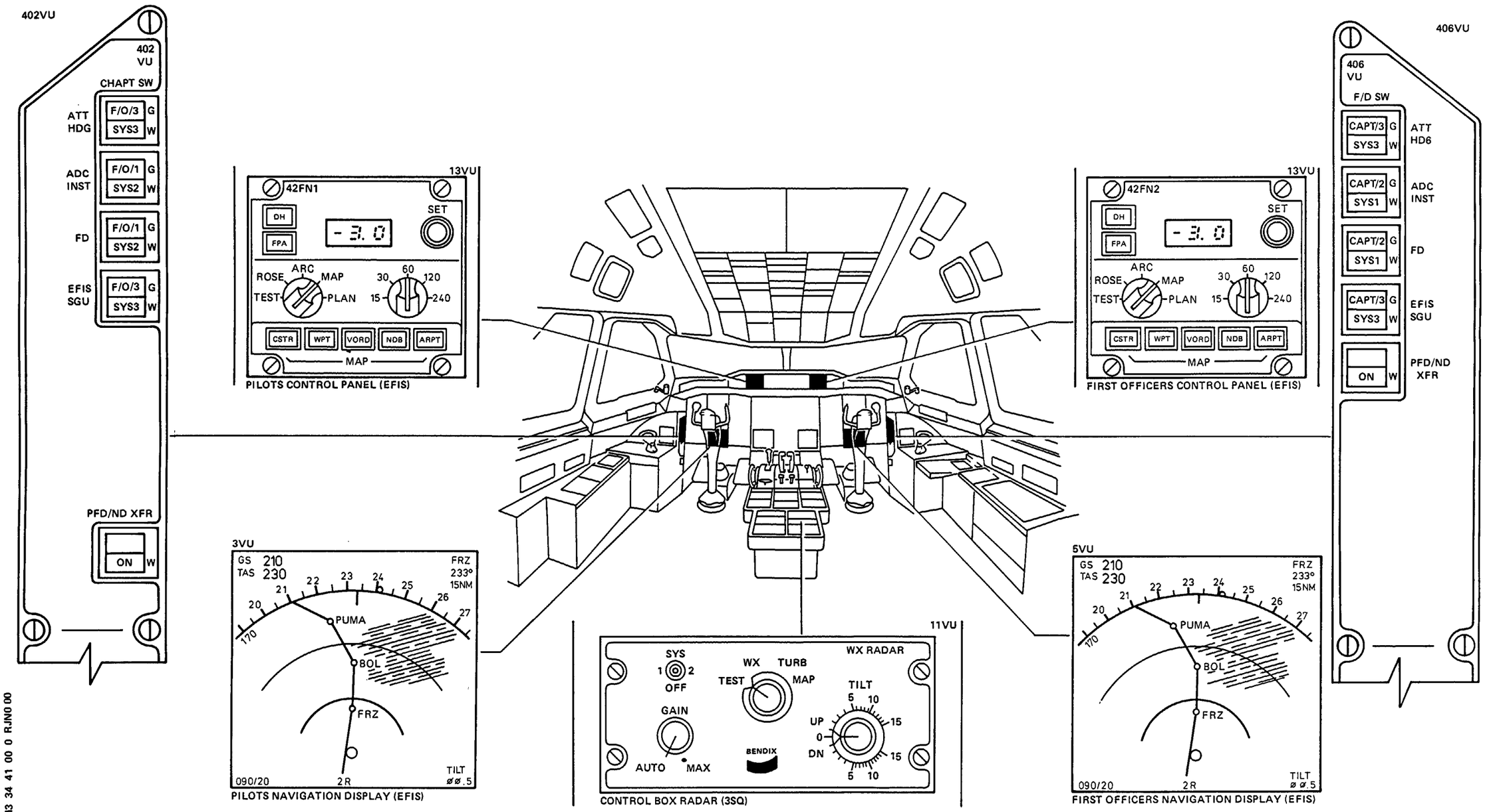
Block Diagram - Weather Radar
Figure 004

R

R EFFECTIVITY: 101-200,

PIA

Printed in France



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Control and Indication
Figure 005

R A. Weather Radar System Components
R The Weather Radar System is designed for single or dual system operation
R and consists of the following components:
R (1)Weather Radar Transceiver (1SQ1), used for transmission of X-band radio
R frequency (RF) pulses and processing of the received echo returns as
R well as for the generation of system power antenna drive signals and
R various control signals.
R (2)Radar Control Box (3SQ), used for various control functions of the
R transceiver in a single or dual system.
R (3)Antenna - Weather Radar Dual Drive (28SQ), used as carrier for antenna
R drive and antenna flat plate planar array and provided with mounting
R surfaces. Full provision is made for use in a dual system.
R (4)Antenna - Weather Radar Flat Plate Planar Array (4SQ), used for
R radiation of RF pulses and reception of associated echo returns.
R (5)Single Shockmount - Weather Radar Transceiver (11SQ), used for the
R installation of the transceiver.
R (6)Waveguide Assembly (14SQ), used as RF transmission line between
R transceiver and antenna.
R (7)Circuit Breaker (7SQ1), applies main power to the transceiver.
R (8)Resistors (29SQ,30SQ,31SQ,32SQ), used as terminations for the data bus
R lines between the transceiver and the Symbol Generator Units (SGU)
R of the EFIS.

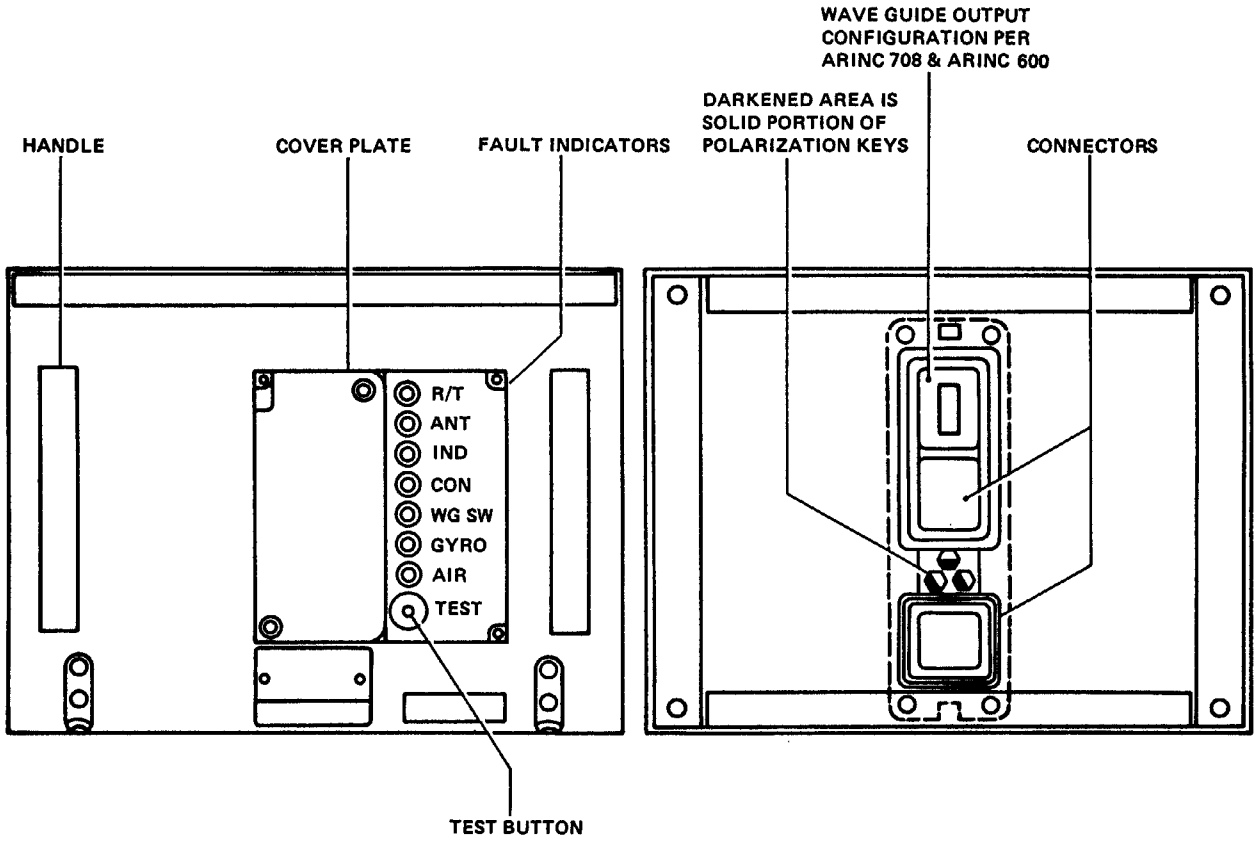
R **ON A/C ALL

B. Weather Radar System Peripherals
The Weather Radar System is fully integrated with the aircraft's Electronic Flight Instrument System. The radar is controlled by the controls of the Weather Radar Control Panel and the controls of the two EFIS Control Panels. With the aircraft power switched on, the radar system, the radar mode, the antenna tilt angle, and the receiver gain may be selected on the radar control panel, while the display mode (ARC or MAP) and the range may be selected on the EFIS Control Panels.
Under control of the EFIS the weather image is displayed on the Navigation Display, while the EFIS data (navigation info, symbols, markers, etc) are superimposed on the weather image (Ref. 34-70-00).
The transceiver propagates a 9.345 GHz signal of approximately 125 W which is routed via the waveguide and radiated by the antenna. The reflected echoes are received by the antenna and routed back to the transceiver where they are amplified and processed to establish several levels of precipitation density for presentation on the coloured Navigation Display of the EFIS.
Turbulences, related to precipitation, are detected and processed with the help of radar doppler techniques to allow its presentation on the Navigation Display.
The weather data is converted into a serial data word and routed to the SGU of the EFIS. After final processing, the data is output to the navigation display.
The data transport between the transceiver and the SGU is realized by two data buses (D1 and D2) in accordance with ARINC 453 while the control

data between the transceiver, the radar control panel, and the EFIS SGU are transported via ARINC 429 control bus lines (C0,C1,C2). The ON SIDE and OFF SIDE attitude values from the aircraft's Internal Reference System (IRS) are used for the stabilization of the radar antenna. They are also transported on ARINC 429 control bus lines. The antenna drive and monitor signals between the transceiver and the antenna dual drive as well as the radar select signals from the SGU are applied as discretes. The data transport between the SGU and the Navigation Displays is realized by EFIS data buses.

4. Component Description

A. Transceiver (1SQ1, 1SQ2)
(Ref. Fig. 006)
(1)Description
The transceiver is a completely solid state airborne unit, containing all the circuits required for the weather radar system. The unit is housed in a single MCU8 package as specified in ARINC characteristic 708. Mounted on the front face of the unit are:
- Two handles to facilitate installation and removal.
- Two ATE connectors (located behind a cover plate).
- 7 fault indicating LEDs.
- Test button.



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Transceiver
Figure 006

At the rear of the unit are:
- Wave guide output connector.
- Electrical connectors.
- 3 connector polarizing keys.

The transceiver provides supply voltages for all its circuits as well as for the antenna dual drive and the radar control panel. It operates at 9345 MHz and transmits 6 and 18 microsecond pulses at one-millisecond intervals during a maximum cycle time of 5.25 ms. Transmitting of two different pulse lengths is done in order to achieve a suitable range resolution for short and long ranges. The TR uses both pulse lengths as follows:
- 6 μs for targets up to 20 nautical miles.
- 6- and 18 μs for targets between 20 and 80 nautical miles.
- 18 μs for targets beyond 80 nautical miles.

The transmitter peak power of approximately 125 W is provided by impatt diodes. Frequency coherence is achieved by using crystal-controlled frequency sources for transmitter and receiver.
The receiver receives weather and ground data signals from -120 dBm to -20 dBm, and triple down converts the received signals to an intermediate frequency of 1.256 MHz. The main stages of the receiver are:
- The RF preamplifier to improve the noise figure at at least 5 dB.
- The AGC controlled 2 ND IF amplifier to maintain the receiver gain.
- The 3 RD IF amplifier with selectable band width filter to match pulse length and receiver bandwidth. For the long pulses a bandwidth of 70 kHz is used, while for the short pulses a bandwidth of 250 kHz is selected.

The videoprocessor in the TR unit digitizes the weather target signals and adjusts the threshold signal level of the digitized weather data with sensitivity timing control (STC), equalizing weather intensity levels from near and far targets. It also adjusts the overall threshold attenuation with penetration compensation to compensate for weakened radar returns from intervening weather targets. The processor determines the weather intensity level by dividing the received data over the selected range into 512 equal increments (512 range bins) and comparing them against fixed threshold levels (2-levels).
The processed data as well as the EFIS data are serially formatted into 1600 bit words by ARINC 453 interfaces to provide weather data for at least three colour indicators.
The TR receives on ARINC 429 control buses serially-formatted 32-bit control words, containing the operating mode, the tilt angle, and other control data from the control panel as well as the selected range and display mode from the EFIS.
The transmitter/receiver operation as well as the video processing are organized and controlled by timing and control circuits. Besides, the monitor circuits and the control bus interface are contained in the timing and control section.

The antenna operation is controlled by an antenna stabilization processor with associated drive circuits. The stabilization processor uses its own ARINC 429 high speed interface for the reception of the aircraft's attitude values.
The transceiver also contains circuits for the indication of turbulences related to areas of precipitation. Therefore the frequency shift, caused by the relative motions of water droplets in the direction of the radar beam, is determined by a doppler processor. The radar detects the spectrum width parallel to the beam axis.
A wide spectrum indicates the presence of turbulence. When the spectrum width exceeds a preselected turbulence threshold of 5 m/s, the doppler processor displays the turbulences as an overlay to the normal weather returns. Therefore the transceiver shifts to an interlaced high and low pulse repetition frequency (PRF) pattern to aquire intensity as well as turbulence information simultaneously. The transmitter transmits a number of short pulses (6 μs) at a PRF of 1600 Hz used for turbulence detection and then a long pulse (18 μs) at a PRF of 190 Hz for weather targets. The turbulence returns are quadrature detected in a linear receiver to obtain in-phase and quadrature-phase signal returns (I- and Q-video) for the doppler processor. Due to the high PRF, turbulences may be detected up to a range of 40 nautical miles while the maximum range (320 nm) for intensity data is limited by the low PRF of 190 Hz.

(2)Specifications:

Power requirements	115 VAC ±10%, 400 Hz, 1.75 amperes
Weight	26.8 lb. (12.02 kg)
Overall Dimensions	Length: 14.51 in. (368.55 mm) inclusive handles Height: 7.785 in. (197.74 mm) Width: 10.09 in. (256.29 mm)
Form Factor	8 MCU, ARINC 708
Cooling	Forced air cooling per ARINC 600
Transmitter Power Ouput	Peak: 125 watts
Pulse Width	6 and 18 microseconds
Pulse Repetition	190 Hz (weather mode), 1600 Hz turbulence mode).
Operating Mode	Pulsed coherent
Frequency	9345 MHz
Maximum Range	320 nm (weather mode), 40 nm (turbulence mode)
Noise Figure	5 dB
Dynamic Range	60 dB minimum
Gain Control	Automatic and manual
Attitude Input	High speed serial data per ARINC 429, 704 (inertial reference) or 705 (altitude and heading reference).
Cycle Time (PRT)	5.25 ms max.
Control Inputs	Low speed ARINC 429
Data Outputs	Three ARINC 453 data buses per ARINC 708

Performance Index	
Penetration	112.4 dB
Avoidance	124.4 dB
Penetration Compensation	Proportional to storm density; effective within range of STC.
Test Pattern	In test mode, furnishes online display with the test pattern.
Self Test	Automatic in regular receiver-transmitter operation. In test mode, furnishes any present fault indication (any of seven) for front panel display.

(3)Operation
(Ref. Fig. 007)
(Ref. Fig. 008)
(a)Regulated Power Supply
The TR contains its own regulated power supply, which, when supplied with 115 VAC 400 Hz reference phase from the aircraft normal supply bus, provides all the necessary power to:
- all integral circuits of the TR (+5 V, -12 V, +12 V, +28 V, -30 V, +70 V)
- weather radar control panel (+12 V, +28 V)
- antenna dual drive unit (115 V AC, 400 Hz)

(b)Frequency Sources
Two frequency sources in the TR provide:
1 A precise reference of 49.709 MHz frequency from a crystal oscillator, accurate to 5 parts in 10^5 from which the range clock frequency of 16.569 MHz is derived, and which is also used after division by 2 for the third LO mixer stage in the receiver section.
2 A crystal oscillator frequency of 78.662 MHz which is used as 2 ND LO frequency after multiplication and for the generation of two intermediate frequencies (XMIT IF and RCV IF) for the transmit and receive circuits. The latter ones are passed to the X9 multiplier stage.

The timing and control circuit determines which frequency is produced. Two one millisecond-spaced trigger 1 pulses from the timing circuit, of 7.5 micro-seconds and 19.5 micro-second duration, instruct the frequency circuit to produce the transmit intermediate frequency. The receive intermediate frequency is automatically produced after the trigger 1 pulses.

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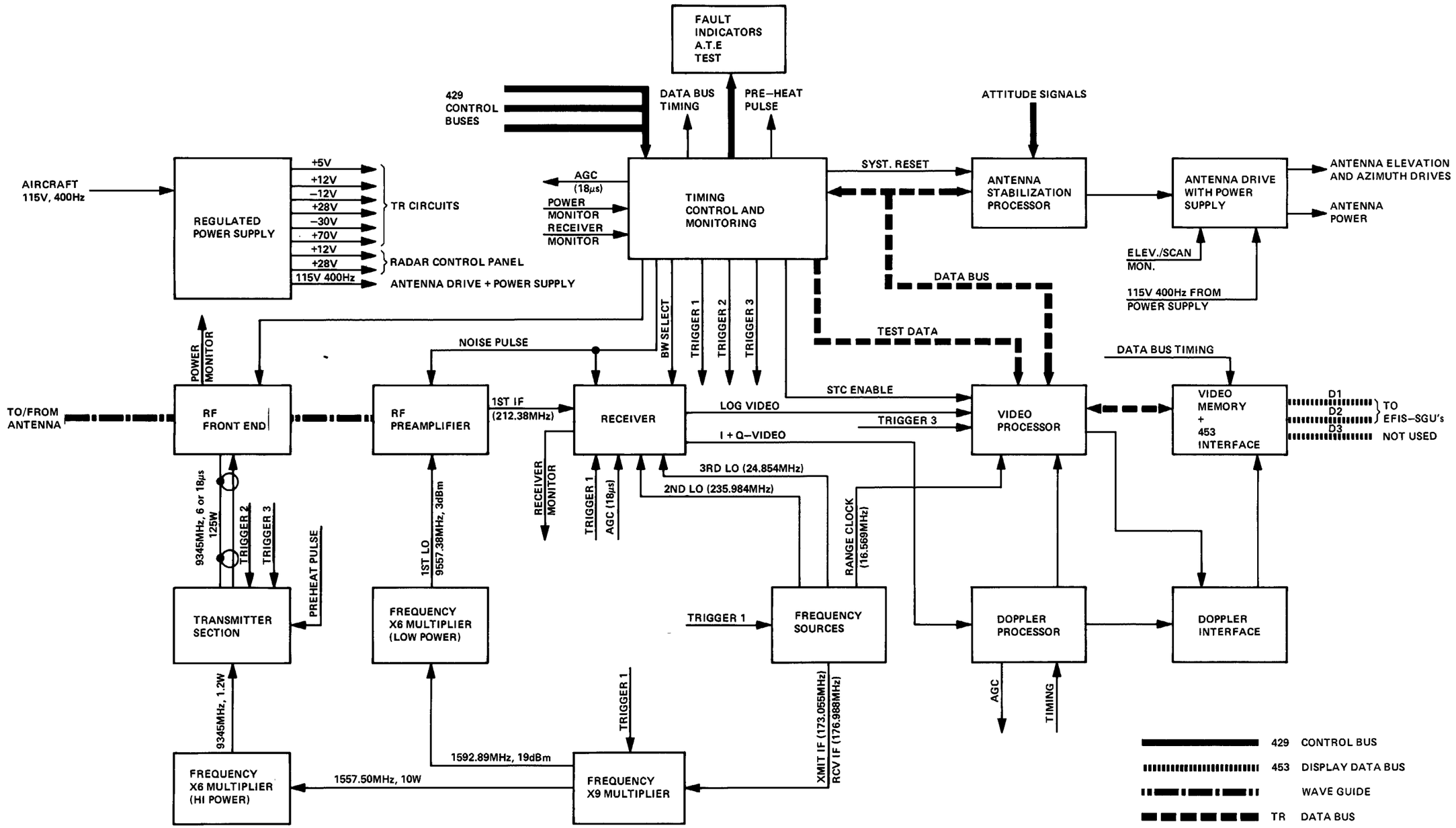

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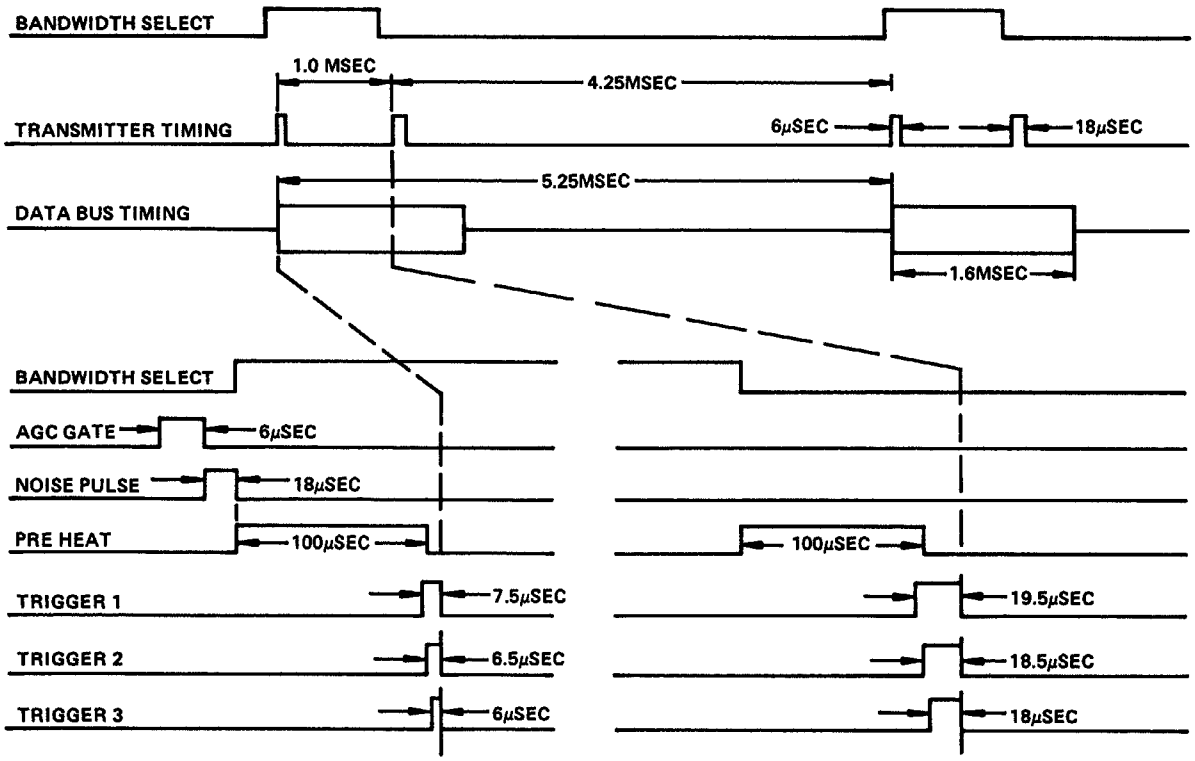
Transceiver - Block Diagram
Figure 007



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Receiver/Transmitter Simplified Timing Diagram
Figure 008

(c)X9 Frequency Multiplier (Ref. Fig. 008)

The X9 frequency multiplier multiplies by 9 the frequencies it receives from the frequency source circuit.

Trigger one pulses from the timing circuit activate a pin diode transmit/receive switch, which allows the developed intermediate transmit signal to pass to a power amplifier, which is switched on by the trigger one pulses for 7.5 μs and 1 ms later for 19.5 ms during each PRT of 5.25 ms.

The power amplifier outputs a pulse modulated 1557.50 MHz signal at 10 W peak power, and routes it to the Hi Power X6 multiplier.

In the absence of trigger one pulses, the receive/transmit switch is in the quiescent (receive) state, and the power amplifier is switched off. The developed intermediate receive signal of 1592.897 MHz at 19 dBm is then directed to the low power X6 frequency multiplier.

(d)X6 Frequency Multipliers

During a transmit period, the high power X6 frequency multiplier receives a pulse modulated signal of 1557.50 MHz at 10 W peak power, and outputs after multiplication the transmitter frequency of 9345 ±0.01 MHz at 1.2 W peak power to the transmitter section.

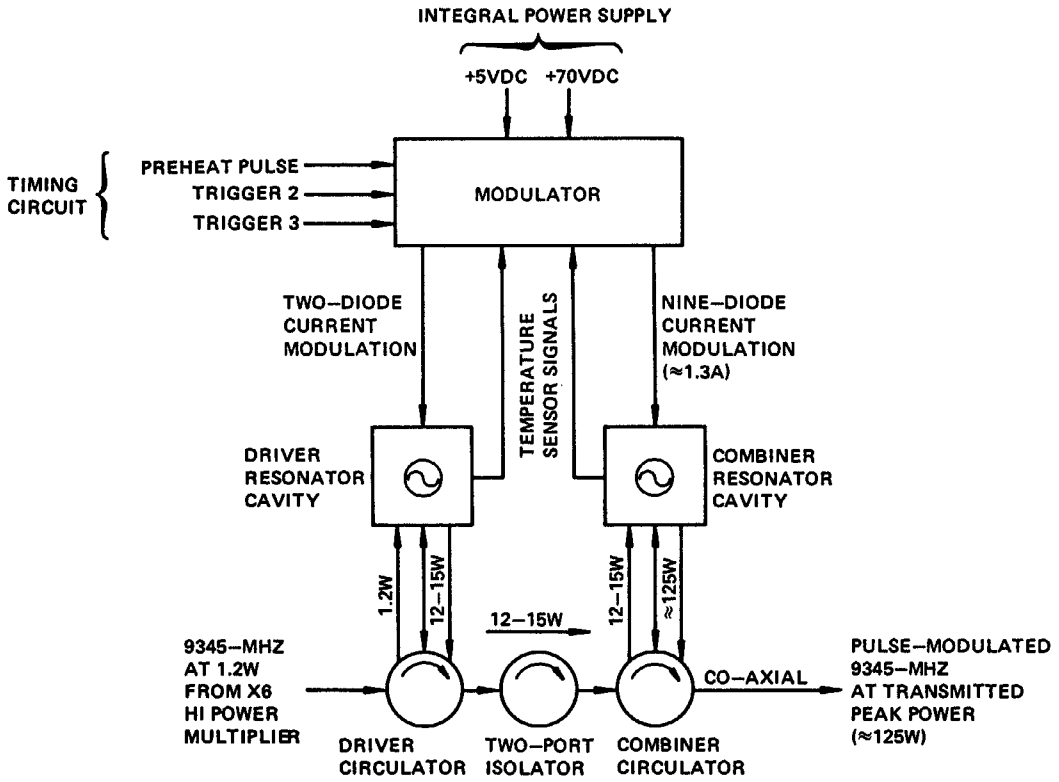
During a receive period, the low power X6 multiplier receives a 1592.879 MHz signal at 19 dBm, and outputs a 9557.38 MHz signal at 3 dBm. This signal is injected into the first low mixer in the RF pre-amplifier as the first low mixer frequency.

(e)Transmitter Section
(Ref. Fig. 008)
(Ref. Fig. 009)
The transmitter section consists of an output power combiner, a driver stage, and a modulator. The output power combiner and driver stage are composed of individual resonator cavities, containing impatt diodes, which develop fundamental power generation at 9.345 GHz.
Each cavity is injection-locked by its RF input signal to provide a phase-coherent transmitter output.
The modulator contains individual current drivers for the impatt diodes. The trigger-pulse commands to the modulator consist of preheat, trigger 2, and trigger 3 pulses.
Approximately one microsecond after the RF input signal of 9345 MHz is applied to the driver stage, the modulator applies current pulses to the driver impatt diodes, when commanded by a positive trigger 2 pulse of either 6.5 or 18.5 microsecond duration. Concurrently, the drive stage outputs an rf pulse of 12 to 15 W power for 6.5 or 18.5 microseconds to the output power combiner. The driver power output is applied to the combiner cavity resonator, after passing through the driver circulator, isolator, and the combiner circulator.
Once the driver RF power signal has been injected into the combiner resonator cavity, the combiner impatt diodes are pulsed on by a current drive signal of 1.3 A from the modulator, when commanded by a trigger 3 pulse of 6 or 18 microseconds duration. This phase-locks the combiner output, which is circulated to a three port circulator in the rf front end, by the combiner circulator. The resultant transmitter output is a 6 or 18 microsecond pulse-modulated, 9345 MHz signal at approximately 125 W.

(f)RF Front End
The RF front end is a wave guide section which couples via a 3-port circulator the transmitter to the antenna, and the antenna to the pre-amplifier.
It provides waveguide to co-axial matching for the transmitter output, and protects the RF pre-amplifier against the effects of transmissions from nearby radar systems with help of a limiter.

(g)RF Pre-Amplifier
The RF pre-amplifier receives the radar return signals, via a waveguide microstrip, from the front end section.
It provides low noise, high gain pre-amplification, and image-rejection filtering and mixing.
After preamplification, the 9345 MHz radar return signals are mixed with the 9557.38 MHz signals from the low power X6 multiplier to produce a receiver intermediate frequency (1ST IF) of 212.38 MHz.

(h)Receiver (Ref. Fig. 008)
The receiver section amplifies the 212.38 MHz 1ST IF signal it receives from the pre-amplifier, and mixes it twice, with two separate frequencies provided by the frequency sources.
The resultant intermediate frequency of 1.236 MHz is applied to a selectable bandwidth filter.
Prior to a 6 microsecond RF pulse transmission the bandwidth is set to 250 kHz by a BW SELECT signal. Before transmission of an 18 micro-



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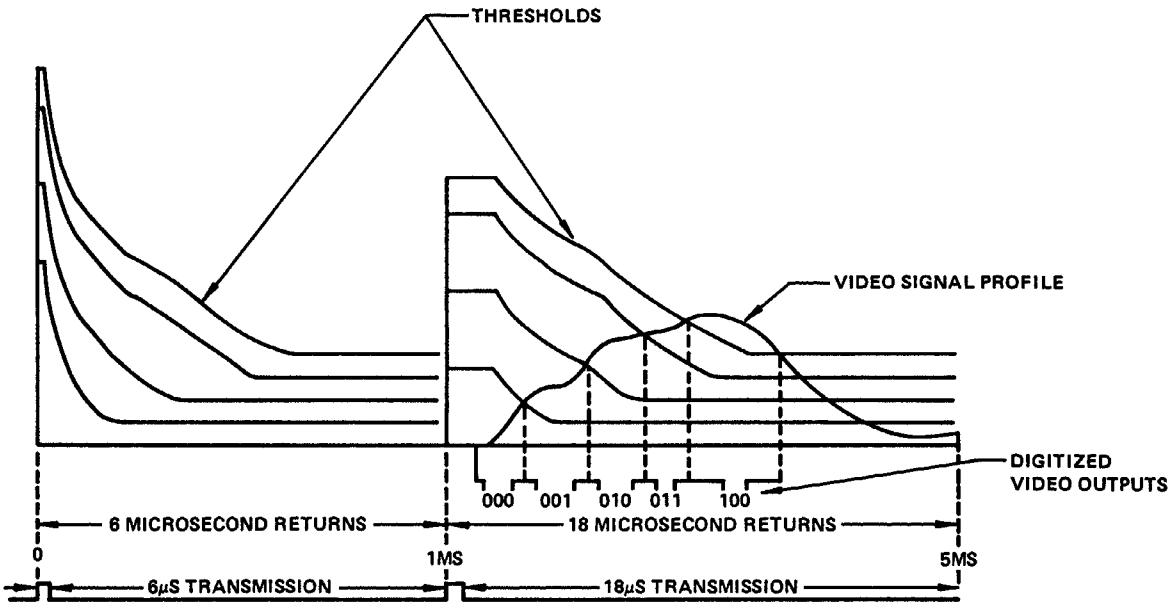
Transmitter Section - Block Diagram
Figure 009

second RF pulse the bandwidth is switched to 70 kHz.
Timing circuit trigger one pulses disable the bandwidth filter during transmission periods.
The filtered intermediate frequency is fed through a logarithmic and a linear amplifier. The logarithmic video is applied to the video processor.
The linear amplifier detects the sin and cos values of the video received and passes the in phase and quadrature phase-videos (I- and Q-video) to the doppler processor.
Constant receiver gain is achieved by sampling and integrating the noise, coming in from beyond the 320 nm radar range, before the next transmission.
Therefore, the timing control produces an AGC gate pulse of 18 µs duration at the end of every listening time.

(j)Video Processor
(Ref. Fig. 010)
(Ref. Fig. 011)
The video processor, consisting of an A/D converter with variable thresholds, scan integrator, gain control, STC PROM, penetration compensator and three range-processors, receives the logarithmic echo returns from the receiver section.
The A/D converter digitizes the echo returns, using four comparators with variable thresholds. These time variable thresholds moreover provide the basis for STC compensation. That means that strong echos from closer targets are compared with higher thresholds and weaker echos from further out targets are compared with lower thresholds. Therefore, the STC PROM contains two sets of firmware-programmed STC thresholds. One set for the 6 µs-returns, the other one for the 18 µs-returns. The resulting signals of the comparison are used to alter the A/D converter thresholds (Ref. Fig. 010).
The penetration compensator contains a weather-intensity factor scale that correlates attenuation levels with intervening precipitation. In this way it determines path loss due to attenuation from intervening precipitation. The resulting signals of the correlation are used to lower the threshold levels for the A/D converter.
The gain control circuit also lowers the threshold level in accordance to the gain, selected on the radar control panel during ground maping mode. The gain data ara send from the control panel with control word 1 on control bus 0 to the timing control of the TR. There they are decoded and passed to the gain control circuit of the video processor.



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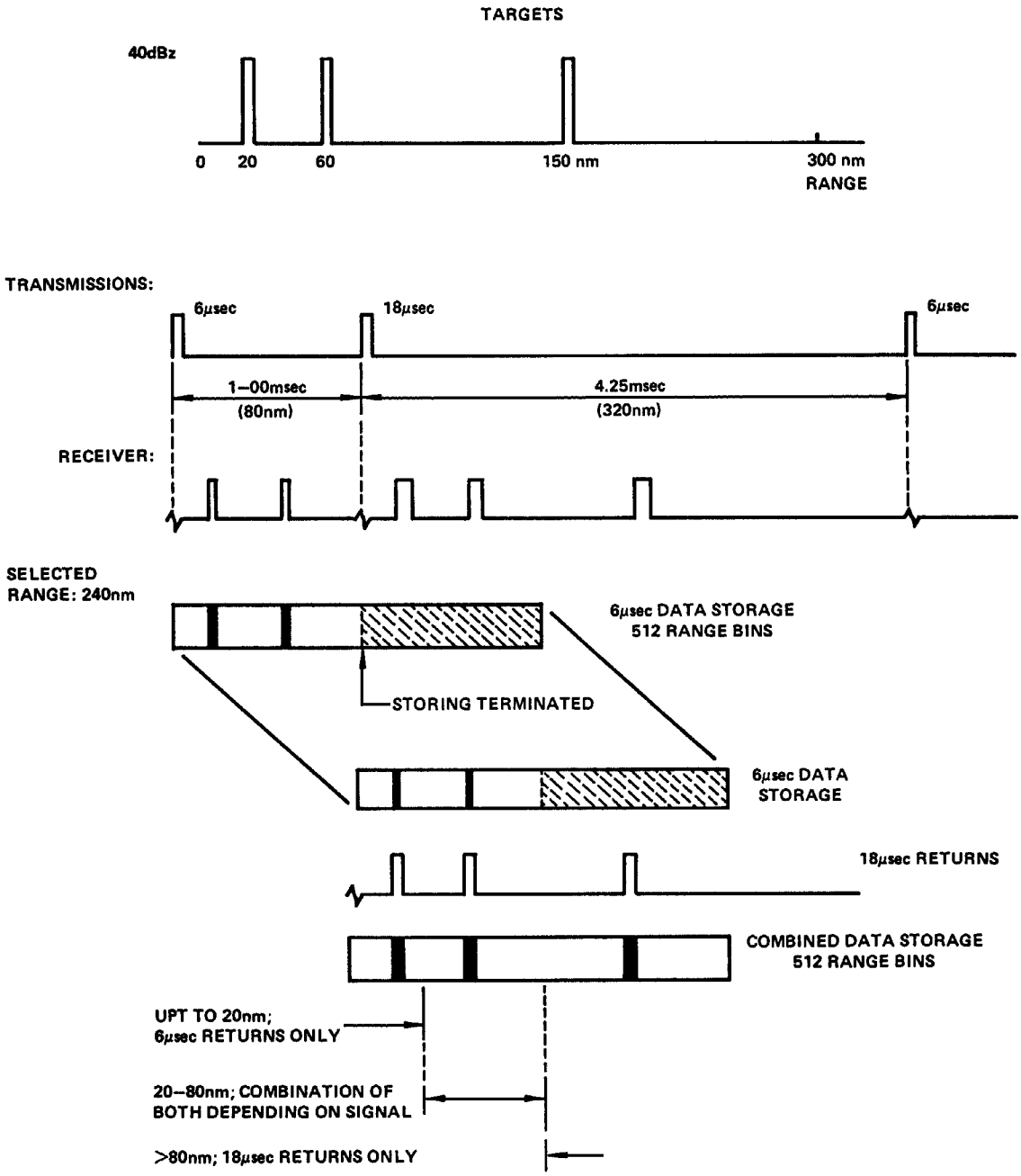
Video Amplitude vs. STC THRESHOLDS
Figure 010



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Combination of 6 µs and 18 µs
Weather Intensity Returns
Figure 011

The echo returns digitized by the A/D converter with respect to the variable thresholds thus representing weather intensity data on four different reflectivity level. The data are sampled by the scan integrator. Each new sample is combined with the echo returns for the same range bin from the previous transmission.
This integration improves the signal-to-noise ratio of the echo returns. The scan integrator contains processed weather intensity data from 0 to 320 nm with a range resolution of 1/16 nm. The data is send to the three range processors where it is combined to provide optimum range resolution for short and long ranges.
The 6 μs and 18 μs pulses are combined as follows:
For targets within 20 nm, only data from the 6 microsecond pulses are used. The 6 and 18 microsecond returns are used for targets between 20-80 nm.
Since the PRF of the transceiver limits the range of the 6 microsecond returns to 80 nm, only the 18 microsecond return pulses are used for targets beyond this range.
After sampling, the data is stored in one of four memory banks. Each memory bank corresponding to 80 nm of range with respect to the 240 nm maximum range of the EFIS.
When instructed by the timing and control circuit, the memory banks output the information to three separate range processors.
The range processors divide the return period into an equal number of range bins (Ref. Fig. 011), where the number is dependent on the range selected. Each range bin will contain three bits of weather information which is sampled at a rate of approximately 1 MHz. Since longer ranges provide more time for sampling, the number of samples integrated varies as a function of range. The following numbers of samples are integrated:

RANGE (NM)	NUMBER OF SAMPLES INTEGRATED
15	1
30	1
60	1
120	3
240	6

Range Integration Samples

The range integration is determined by the sample require frequency (SR) and the sample acquire frequency (SA).

Sample require (SR) is the frequency at which the samples are written into a video memory and can be expressed:

$$SR = \frac{512}{RANGE \times 12.36}$$

Where 12.36 μs = time used by the electromagnetic waves to travel one nautical mile.
Sample acquire (SA) is the basic sampling frequency which is approximately 1 MHz for all ranges. This can be expressed:

$$SA = \frac{SR}{n}$$

where n = number of samples integrated.

It should be noted that the number of bins generated for the 15 and 30 nautical mile ranges differ from the 512 bins generated for other ranges. This is due to insufficient processing time for the closer ranges. Thus, 128 range bins are generated for the 15 mile range and 256 bins for the 30 mile range. Since ARINC 453 data format requires 512 samples to the EFIS SGUs, the 15 mile range data is fed four times (4 X 128 = 512) and the 30 mile range data is fed twice (2 X 256 = 512) to the SGUs. This data transfer is accomplished by the video memory module.

(k)Video Memory and ARINC 453 Interface
(Ref. Fig. 008)
(Ref. Fig. 012)
The timing and control circuits control the operation of video memories 1, 2, and 3 (only 1 and 2 used) which are dedicated to 453 data buses 1 and 2 respectively. While 512 range bins (512 x 3 bits) of range processed weather intensity data and/or turbulence data as well as 64 bits of control data are written into a video memory to make up the 1600 bits of a display data word, two 453 bus drivers transmit the 1600-bit display data words on two 453 data buses to three symbol generators of the Electronic Flight Instrument System (EFIS).
Each video memory consists of two identical 1K X 4-bit RAMs, memory banks A and B. This arrangement allows the 64 control bits and 512 range bins (1600 bits) to be written into one memory bank, while 1600 bits of a display data word is serially read out from the other memory bank.
This alternating write-read memory-bank operation is performed during each repetitive receiver-transmitter period of 5.25 milliseconds. During this time, a display data word of 1.6 milliseconds duration is serially shifted out from a memory bank (A or B) at a 1 MHz bit rate and transmitted on a 453 data bus (D1 or D2) to symbol generators 1 and 3 of the EFIS or to symbol generator 2 and 3 respectively.
The timing and control circuit microprocessor controls the alternating write/read operation at memory banks A and B of the video memories.

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WXR DATA	END OF WORD SYNC	RANGE BIN 512	RANGE BIN 1	SPARE	SCAN ANGLE	DATA ACCEPT	SPARE	RANGE	GAIN	TILT	OPERA-TIONAL MODE	STAB	FAULTS	MODE ANNUNCIATION	SPARE	SLAVE	CONTROL ACCEPT	LABEL WXR DATA	BEGINNING OF WORD SYNC
BIT NO.		11 65 09 08	66 65	64	66 66 55 55 55 55 55 55	55	49	44 44 44 44 44 43	44 43 33 33 33 37	33 33 33 33 33 36	22 28 27	26	22 22 22 21 20 19	11 11 11 11	11 32	11	10	87 65 43 21	
EXAMPLE		010	000	0	01 11 01 00 00 00	11	0	00 11 11 0	11 11 11	00 00 00 00	000	0	00 00 00 00	00 00 00	00	0	11	10 11 01 00	
NOTES	1	2	2	15	3	4	15	5	6	7	8	9	10	11	15	12	13	14	1

DATA

CONTROL

NOTES:
1. BEGINNING AND END OF WORD SYNCHRONIZATION.

2. RELFECTIVITY DATA

BITS 65 - 1600
BIN NO. 512

1600	1599	1598

BIN NO.1			FUNCTION/LEVEL
67	66	65	
0	0	0	Less than Z2
0	0	1	Z2 to Z3
0	1	0	Z3 to Z4
0	1	1	Z4 to Z5
1	0	0	Greater than Z5 (Not yet used)

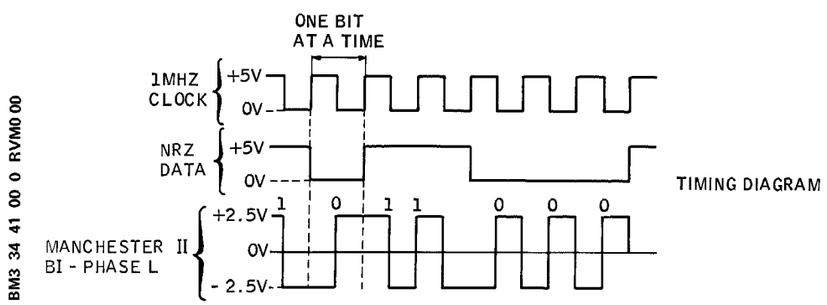
3. SCAN ANGLE

BIT	
63	+180 DEG
62	+90
61	+45
60	+22.5
59	+11.25
58	+5.625

BIT	
57	+2.8125 DEG
56	+1.40625
55	+0.703125
54	+0.3515625
53	+0.17578125
52	+0.087890625

0 DEG IS DEAD AHEAD
+90 DEG IS RIGHT WING

4. DATA ACCEPT
BITS 50 AND 51 ARE ALWAYS SET TO 1.



5. RANGE

BIT 48	47	46	45	44	43	
0	0	0	0	0	1	5 NM
0	0	0	0	1	0	10
0	0	0	1	0	0	20
0	0	1	0	0	0	40
0	1	0	0	0	0	80
1	0	0	0	0	0	160
1	1	1	1	1	1	315
0	0	0	0	0	0	320

6. GAIN

BIT 42	41	40	39	38	37	
1	1	1	1	1	1	CAL
0	0	0	0	0	0	MAX
0	0	0	1	0	1	-5
0	0	1	0	1	1	-11
1	1	1	1	1	1	-62

7. ANTENNA TILT
TWO'S COMPLIMENT TILT

BIT	
36	-16 DEG
35	+ 8
34	+4
33	+2
32	+1
31	+0.5
30	+0.25

8. OPERATIONAL MODE

MATRIX CODE	29	28	27	OPERATING MODE
1	0	0	1	WEATHER
2	0	1	0	MAP (NOT USED)
4	1	0	0	TEST

9. STAB
BIT 26

0 = STABILIZATION OFF
1 = STABILIZATION ON

10. FAULTS (CODED INDEPENDENTLY)

BIT 25	24	23	22	21	20	19	
0	0	0	0	0	0	0	NO DETECTED FAULTS
1	0	0	0	0	0	0	TRANSMITTER /RECEIVER FAULT
0	1	0	0	0	0	0	ANTENNA FAULT
0	0	1	0	0	0	0	CONTROL FAULT
0	0	0	1	0	0	0	ATTITUDE INPUT FAULT
0	0	0	0	1	0	0	CALIBRATION FAULT (T-R)
0	0	0	0	0	1	0	DISPLAY FAULT
0	0	0	0	0	0	1	T/R COOLING FAULT (OVER TEMPERATURE)

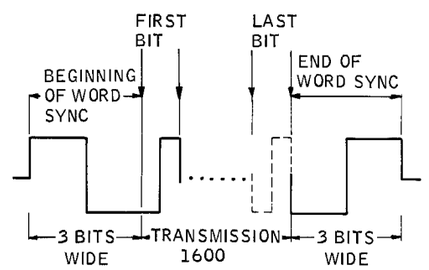
11. MODE ANNUNCIATION
BITS 14 THROUGH 18 ARE NOT USED.

12. SLAVE
BIT 11 IS ALWAYS SET TO 0.

13. CONTROL ACCEPT BITS 9 AND 10 ARE ALWAYS SET TO 1.

14. LABEL
BITS 1-8 OCTAL 055

15. SPARE
BITS 12, 13, 49, AND 64 ARE SPARE



DISPLAY DATA WORD SYNCHRONIZATION (NOTE 1)

ARINC 453 Display Word Format
Figure 012

EFFECTIVITY: ALL

R

PIA

The 1600 bits, supplied on video display non-return-to-zero (NRZ) data levels, are combined with the 1 MHz dock to achieve a Manchester II Bi-Phase code as required by the 453 data bus. In this code a positive pulse followed by a negative pulse indicates a logic 1 while a negative pulse followed by a positive pulse represents a logic 0. Data word synchronization is achieved by synchronization pulses of three bits duration (3 μs), initiating and terminating each data word. The sync pulses are used to provide a check of the 1600 bit word format.

(l)Timing, Control and Monitoring

(Ref. Fig. 013)

The timing, control and monitoring circuit consists essentially of a basic microcomputer. It contains all the firmware programmed instructions for running the receiver-transmitter operation, built-in tests, and performance monitoring. Two control words of 32 bits, control word one (octal 270) from the weather radar control panel, and control word two (octal 271) from either one or both EFIS control panels, together with information from the antenna stabilization microprocessor are used by a microprocessor to control the transceiver operations. The timing and control circuit microprocessor has a cycle time of 500 nanoseconds, and operates most of the time under a continuous main loop.

At fixed intervals of the main loop, it:

- updates the data stored in the video memories
- causes the generation of timing and control signals for the transceiver operations
- monitors for any fault conditions
- processes the required antenna scan angle for the antenna stabilization microprocessor.

The continuous main loop can be interrupted by:

- a change in the Arinc 429 control words (octals 270 and 271)
- an update interrupt from the video control circuit
- an enable test switch, which calls up any fault conditions
- a remote test switch which causes a test signal to be generated.

During each 5.25 millisecond period of transceiver operation, the timing and control circuits also monitor the operation of:

- all principal functional circuits
- control panels
- antenna dual drive
- wave guide switch
- attitude inputs
- data buses.

INTENTIONALLY BLANK

Printed in France

WXR CONTROL WORD 1	P	MATRIX	GAIN	TILT	MODE	STAB	ANTICLUTTER SCAN	SDI (RES)	LABEL WXR CONTROL WORD 1
BIT NO.	32	31 30	29 28 27 26 25 24	23 22 21 20 19 18 17	16 15 14	13	12 11	10 9	8 7 6 5 4 3 2 1
EXAMPLE	Ø	Ø Ø	1 1 1 1 1 1	Ø Ø Ø Ø Ø Ø Ø	Ø Ø Ø	1	Ø Ø	Ø Ø	0 0 0 1 1 1 0 1
NOTES	9	8	7	6	5	4	3	2	1

NOTES:

1 LABEL
BITS 1-8
OCTAL 27Ø

2 SDI
RESERVED
ARINC
CHAR 429

3 REDUCED SECTOR SCAN ANGLE
BIT 11
ALWAYS SET TO Ø
Ø = NORMAL
1 = REDUCED SECTOR SCAN (NOT USED)

ANTICLUTTER
BIT 12
ALWAYS SET TO Ø
Ø = ANTICLUTTER OFF (NORMAL)
1 = ANTICLUTTER ON (NOT USED)

4 STAB
BIT 13
ALWAYS SET TO 1
Ø = STABILIZATION OFF (NOT USED)
1 = STABILIZATION ON

5 MODE

BIT 16	15	14	
Ø	Ø	Ø	STANDBY
Ø	Ø	1	WX (ONLY)
Ø	1	Ø	MAP (ONLY) (NOT USED)
Ø	1	1	CONTOUR (NOT USED)
1	Ø	Ø	TEST
1	Ø	1	TURB (ONLY) (NOT USED)
1	1	Ø	WX+TURB (NOT USED)
1	1	1	SPARE

6 TILT
TWO'S COMPLEMENT TILT

BIT	
23	-16 DEG (SIGN)
22	+8
21	+4
20	+2
19	+1
18	+0.5
17	+0.25

WHEN BIT 23 IS SET TO 1 AND BITS 22 THROUGH 17 ARE SET TO Ø THE SYSTEM SHOULD BE PLACED IN AN AUTOMATIC TILT CONTROL MODE. } NOT USED

7 GAIN

BIT 29	28	27	26	25	24	
1	1	1	1	1	1	CAL
Ø	Ø	Ø	Ø	Ø	Ø	MAX
Ø	Ø	Ø	1	Ø	1	-5
Ø	Ø	1	Ø	1	1	-11
1	1	1	1	1	Ø	-62

8 MATRIX

BIT 31	30	
Ø	Ø	VALID DATA
Ø	1	INVALID DATA
1	Ø	TEST
1	1	SLAVE

9 PARITY
BIT 32
SET TO RENDER ODD PARITY

10 TRANSMISSION INTERVAL
100 mS MAX

WXR CONTROL WORD 2	P		RANGE	SPARE	SDI (RES)	LABEL WXR CONTROL WORD 2
BIT NO.	32	31 30	29 28 27 26 25 24	23 22 21 20 19 18 17 16 15 14 13 12 11	10 9	8 7 6 5 4 3 2 1
EXAMPLE	1	Ø Ø	Ø Ø 1 1 1 Ø	Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø Ø	Ø Ø	1 0 0 1 1 1 0 1
NOTES	6	5	4	3	2	1

NOTES:

1 LABEL
BITS 1-8
OCTAL 271

2 SDI
BITS 9-10
RESERVED
ARINC
CHARAC 429

3 SPARE
BITS 11-23

4 RANGE

BIT 29	28	27	26	25	24	
Ø	Ø	Ø	Ø	Ø	1	5 MILES
Ø	Ø	Ø	Ø	1	Ø	10
Ø	Ø	Ø	1	Ø	Ø	20
Ø	Ø	1	Ø	Ø	Ø	40
Ø	1	Ø	Ø	Ø	Ø	80
1	Ø	Ø	Ø	Ø	Ø	160
1	1	1	1	1	1	315
Ø	Ø	Ø	Ø	Ø	Ø	320

5 MATRIX

BIT 31	30	
Ø	Ø	VALID DATA
Ø	1	INVALID DATA
1	Ø	NOT USED
1	1	SLAVE

6 PARITY
BIT 32
SET TO RENDER ODD PARITY

7 TRANSMISSION INTERVAL
100 mS MAX

CONTROL WORD 1 OCTAL 270 - WRX CONTROL PANEL → XCVR
CONTROL WORD 2 OCTAL 271 - EFIS CONTROL PANEL → XCVR+SGU

BM3 34 41 00 0 RWM000

Serial Control Data
Figure 013

(m)Fault Indicators and ATE Test Module
When the test button on the transceiver front face is pressed, all fault indicating lights come on for one second, then go out. Should a fault have been detected by the monitoring circuit, the appropriate light will remain on (for as long as the test button is pressed). Besides, if a fault is present in the system, it is stored in a fault log of the ATE test module. This storage is used for fault isolation in a repair shop by means of an TR testset. The TR frontpanel is provided with test connectors for the connection of the testset.

(n)Antenna Stabilization Processor and Antenna Drive Circuits
The stabilization processor together with its associated drive circuits controls the antenna dual drive operation. Besides, it realizes a fault analysis for the dual drive. A more detailed description is given in paragraph 4.B(2)(e) (antenna dual drive operation).

(o)Doppler Processor

The doppler processor accepts the in-phase and quadrature-phase echo returns from the linear receiver, received over a range of 40 nm. It divides the range into 256 range bins and converts the analog echo returns into digital I- and Q-signals. Both I- and Q-returns are then delayed by one PRF in a delay RAM to obtain Id- and Qd-returns. By carrying out complex multiplications between two successive pulses a multiplier accumulator (MAC) determines the doppler shift (the velocity) of the targets contained in each range bin. The MAC also calculates the power level of the returns for automatic gain control of the linear receiver.

The AGC loop provides 50 dB of useful dynamic range in the linear receiver. This is achieved by a power evaluator which calculates the power level for each range bin and forwards a gain correction to an integrator. The gain correction signals are integrated and passed through a D/A converter to the receiver.

The MAC outputs (corresponding to moving water droplets caused by turbulences) are applied to an azimuth filter for compensation of the antenna scan rate. The compensated signals then are applied to a statistical variance estimator which determines the spectrum width of the returns. A threshold comparator accepts the spectrum width outputs of the variance estimator and compares it to a turbulent threshold of 5 m/s. If the spectrum width exceeds the threshold, the weather returns are identified as turbulent and passed to the doppler interface.

The doppler shifts, caused by the radar beam broadening effect, are compensated by altering the threshold level with respect to the antenna tilt- and scan angle and the selected range.

The doppler processor contains also a test pattern generator which provides a test pattern during system test.

(p)Doppler Interface

The doppler interface receives the turbulent returns from the doppler processor as well as the weather intensity data from the video processor. It superimposes the turbulence returns on the weather intensity data and forwards the resulting weather pattern to the 453 interface.

Since the doppler processing is sensitive to the signal-to-noise ratio of the returns, the interface qualifies the turbulence output by monitoring the signal-to-noise ratio of the returns.

The turbulence returns are displayed on precipitation level 5 on the navigation displays of the EFIS.

B. Radar Control Box (3SQ)

(1)Description

The control panel is a solid state airborne unit containing the circuits and controls required for the control of at least two transceiver units. The housing is made in accordance to ARINC 708 specifications.

The control panel receives its power from the selected transceiver as unregulated DC voltages. It contains voltage regulators to regulate and filter the input power. Besides, the panel receives 5 V AC from the aircrafts panel lighting system.

The tilt and gain control signals from the front controls are conver-

ted into digital values by means of an A/D converter and applied to a data formatter together with the data from the mode control knob. The formatter formats the data into the 32 bits control word number one and passes it to an ARINC 429 interface. The interface converts the word into bipolar signal levels as required by 429 control buses and forwards it to the transceiver when the transceiver timing and and control sends a request.

(2)Specifications

Power Requirements	12 V DC and 28 V DC supplied by the transceiver
Weight	1.9 lb. (0.86 kg)
Dimensions	Length: 6.00 in. (152.4 mm) inclusive connectors Height: 2.48 in. (63.0 mm) Width: 5.00 in. (127.0 mm)
Form Factor	ARINC 708
Output	Low speed ARINC 429

(3)Operation

(Ref. Fig. 013)
(Ref. Fig. 014)
(Ref. Fig. 015)

R **ON A/C 001-100,

(a)The SYS 1/OFF/2 switch, when selected to SYS1 or SYS2, puts power from the transceiver 1 power supply to transceiver 1 or from transceiver 2 power supply to transceiver 2 via the waveguide switch. The radar control box generates the control word number 1 which is passed on a 429 data bus to the transceiver.

(b)The TILT control allows the crew to alter the elevation axis of the planar array up to ±15° from the aircraft principal axis.

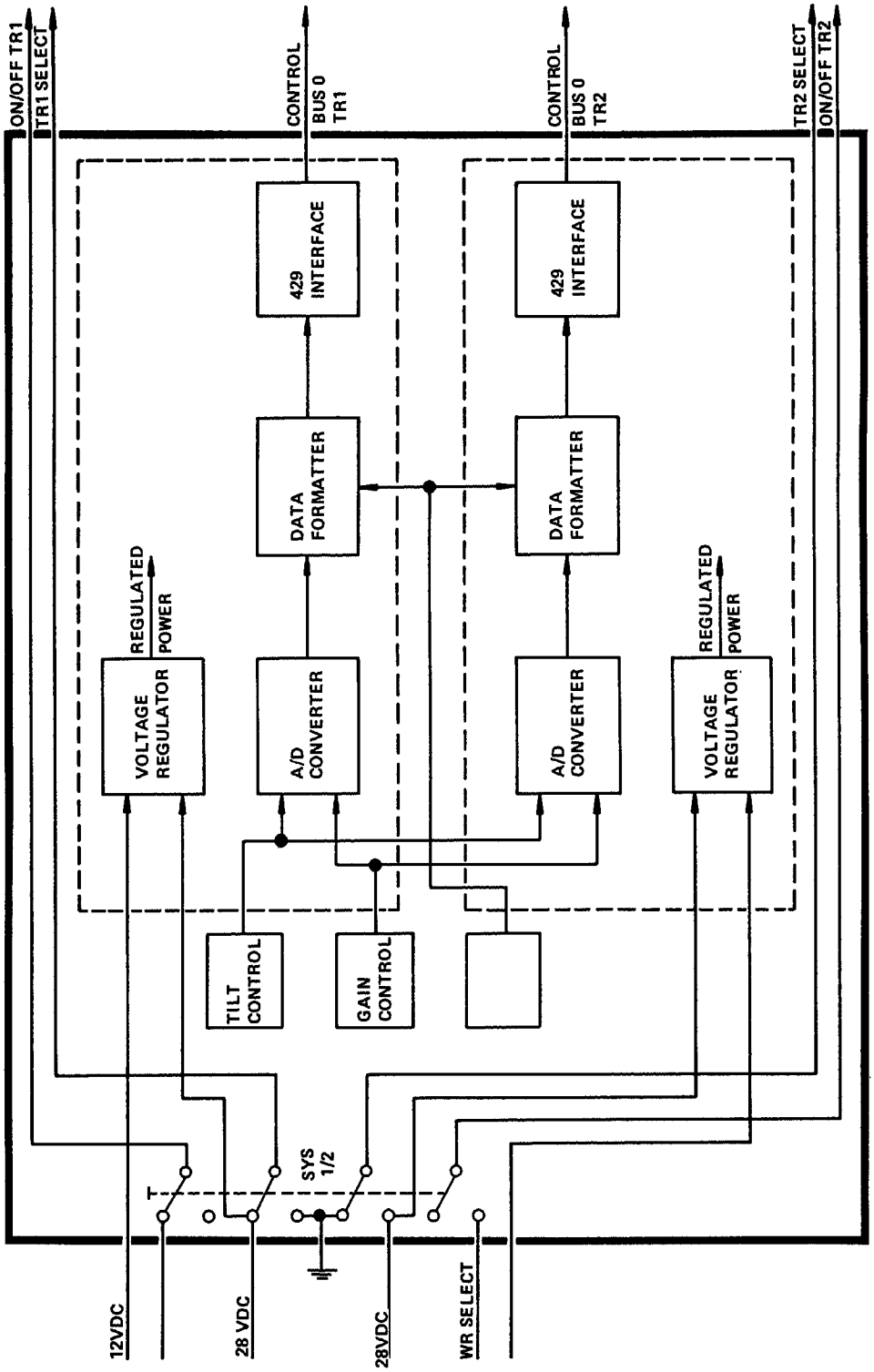
(c)The mode selector is used to select the desired mode of operation; i.e. TEST, WX, TURB and MAP. TEST places the system in self test to determine the operational status of the system. WX is used for observing weather conditions. MAP is used for ground mapping. TURB is used for the detection of turbulences related to precipitations.

NOTE : Turbulence information is limited to the first 40 nautical miles.

(d)The GAIN control is used to adjust the gain of the receiver in MAP mode only. Set to AUTO (automatic) position, gain is preset to provide optimum operation. In WX and TURB mode, gain is automatic regardless of gain control position.

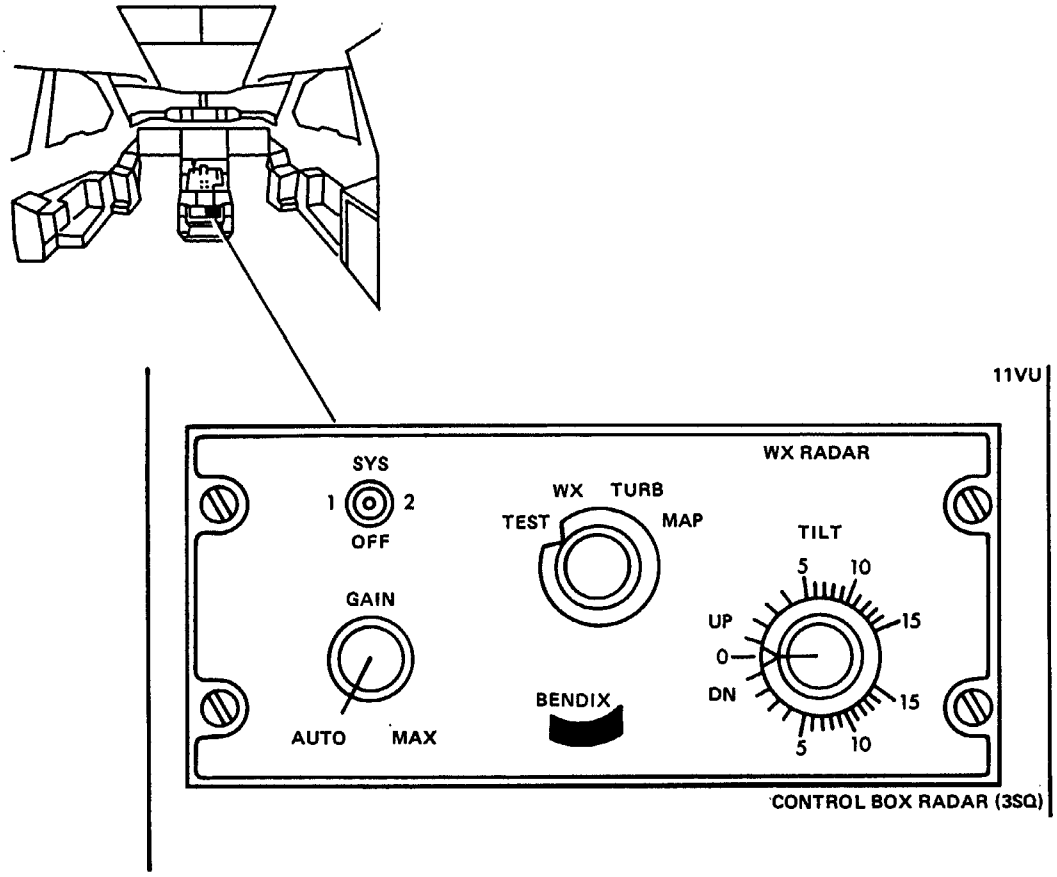
R **ON A/C 101-200,

R (a)The SYS 1/OFF/2 switch, when selected to SYS1, puts
R power from the transceiver 1 power supply to transceiver 1. The
R position SYS2 of this switch is not connected.
R The radar control box generates the control word number 1 which is
R passed on a 429 data bus to the transceiver.



BM3 34 41 00 0 RER0 00

Radar Control Box - Block Diagram
Figure 014



BM3 34 41 00 0 REN0 00

Radar Control Box
Figure 015

R (b)The TILT control allows the crew to alter the elevation axis of
R the planar array up to ±15° from the aircraft principal axis.
R (c)The mode selector is used to select the desired mode of operation;
R i.e. TEST, WX, TURB and MAP. TEST places the system in self test to
R determine the operational status of the system. WX is used for
R observing weather conditions. MAP is used for ground mapping.
R TURB is used for the detection of turbulences related to pre-
R cipitations.
R
R NOTE : Turbulence information is limited to the first 40 nautical
R miles.
R
R (d)The GAIN control is used to adjust the gain of the receiver in MAP
R mode only. Set to AUTO (automatic) position, gain is preset to provide
R optimum operation. In WX and TURB mode, gain is automatic regardless
R of gain control position.

R **ON A/C ALL

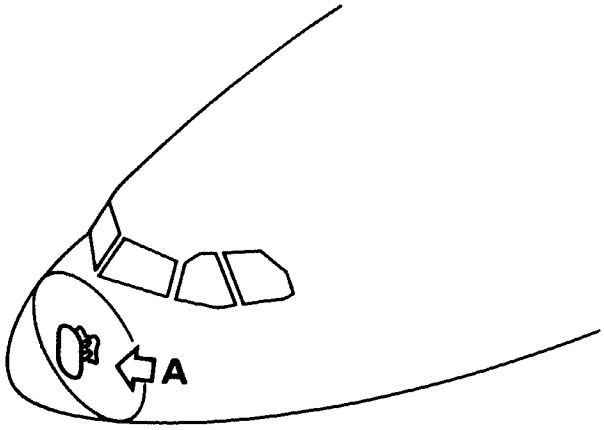
C. Antenna Flat Plate (4SQ
(Ref. Fig. 016)

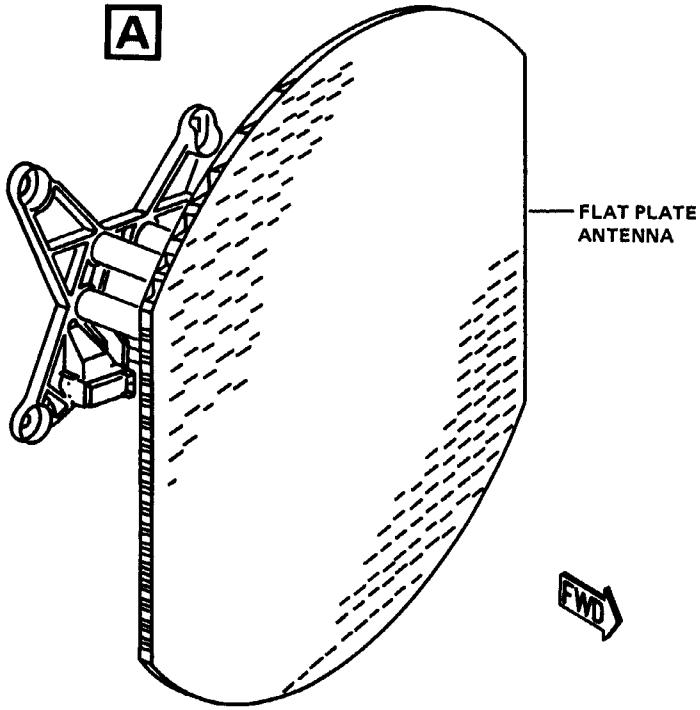
(1)Description

The planar array is a 30 inch flat plate antenna, mounted on the yoke assembly of the dual drive unit pedestal assembly.
The required pencil beam radiation pattern is developed by means of phase reinforcement/cancellation of RF energy from adjacent slots in the planar array.
Stabilization is provided for the planar array, covering normal aircraft manoeuvers, to ensure that reflected radiation signals are presented coherently to the signal processing circuits of the weather radar system.

(2)Specifications

Weight	6.5 lb. (2.95 kg)
Size	29.80 in. (756.92 mm) height
	27.20 in. (690.88 mm) width
	1.48 in. (37.6 mm) depth
Beam width	3.6°
Beam hight	3.4°
Gain	35 dB
Frequency	9.345 GHz ± 30 MHz





BM3 34 41 00 0 REM0 00

Antenna Flat Plate
Figure 016

D. Antenna Dual Drive Unit (28SQ)
(Ref. Fig. 017)

(1)Description

The drive unit is a modular assembly consisting of fixed and movable parts. It is designed for use in dual system installations and has dual electrical connectors and dual azimuth and elevation position sensors.

(a)Pedestal Assembly

The pedestal assembly serves as the mount for the entire antenna assembly. It is provided with a waveguide at the top, two electrical connectors at the bottom, and carries a cantilevered yoke assembly.

(b)Yoke Assembly

This yoke assembly holds and supports the azimuth scan drive assembly, the azimuth rotary joint and the elevation yoke assembly. The azimuth drive is a motor/gear-train/synchro assembly, which provides the required azimuth drive signals and monitor signals.

(c)Elevation Yoke Assembly

This yoke assembly supports the planar array and elevation drive assembly, with counter balance spring and elevation rotary joint assembly. The elevation drive is a similar motor/gear-train/synchro assembly as the azimuth drive.

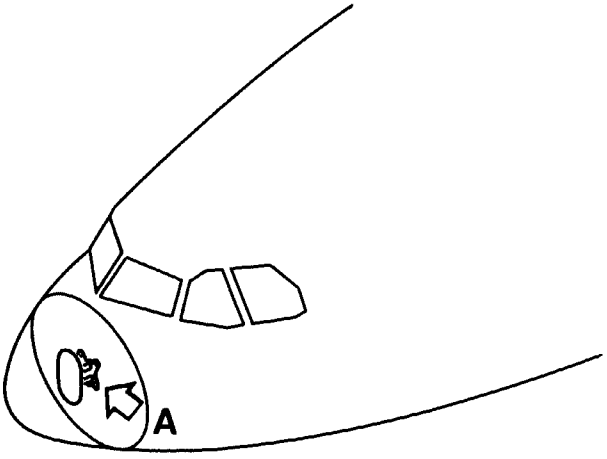
NOTE : Both drives may be switched off for maintenance purposes by means of AZ- and EL-switches mounted on the pedestal assembly. The drive assemblies are provided with dials for adjustment purposes.

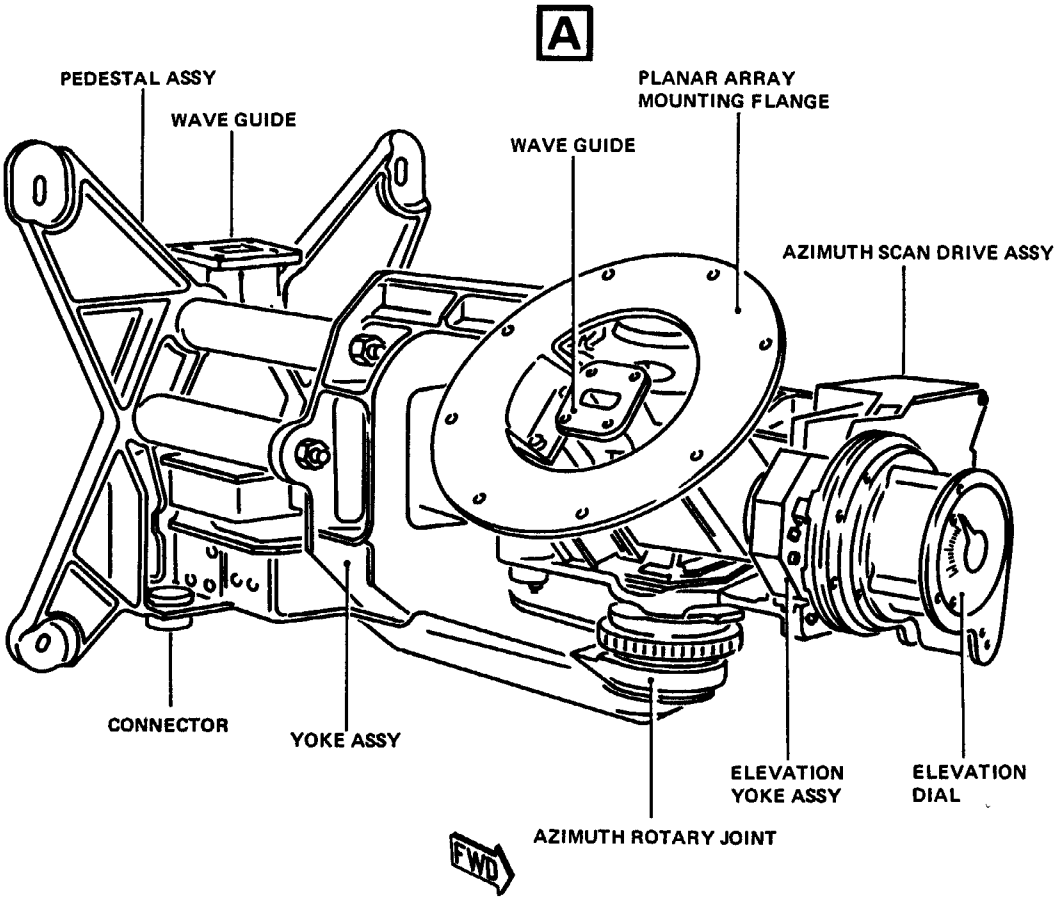
(d)Rotary Joints

The two rotary joints are microwave components placed in the waveguide transmission line to allow RF energy to be coupled from the stationary waveguide in the pedestal, through the rotatable parts of the antenna assembly, and then to the planar array. Sealed ball bearings keep the fixed and rotating sections of the rotary joints in alignment, and allow for minimum friction. Each rotary joint is a matched assembly, and must be replaced in its entirety if damaged. It is bolted into place without adjustment, shimming or pinning.

(2)Specifications

Power Requirements	115 V AC ±10%, 400 Hz, 0.75 amperes
Weight - Pedestal Assembly	22.75 lb. (10.32 kg)
Scan Range	180°
Scan Rate	15 looks per minute
Frequency	9345 ± 10 MHz
Stabilization Range	
Manual Tilt	±15°
Pitch	±25°
Roll	±40°
Combined Tilt/Pitch/Roll	±45°
Stabilization Rate	20°/second pitch or roll rate





BM3 34 41 00 0 RGM0 00

Antenna Dual Drive Unit
Figure 017

Stabilization Accuracy	
Static	±0.25°
Dynamic	±0.50° follow-up error with above stabilization rates. (These errors do not include gyro input errors, radome beam distortion, or installation alignment errors.

(3)Operation

R **ON A/C 001-100,

(Ref. Fig. 018)

R **ON A/C 101-200,

R (Ref. Fig. 019)

R **ON A/C 001-100,

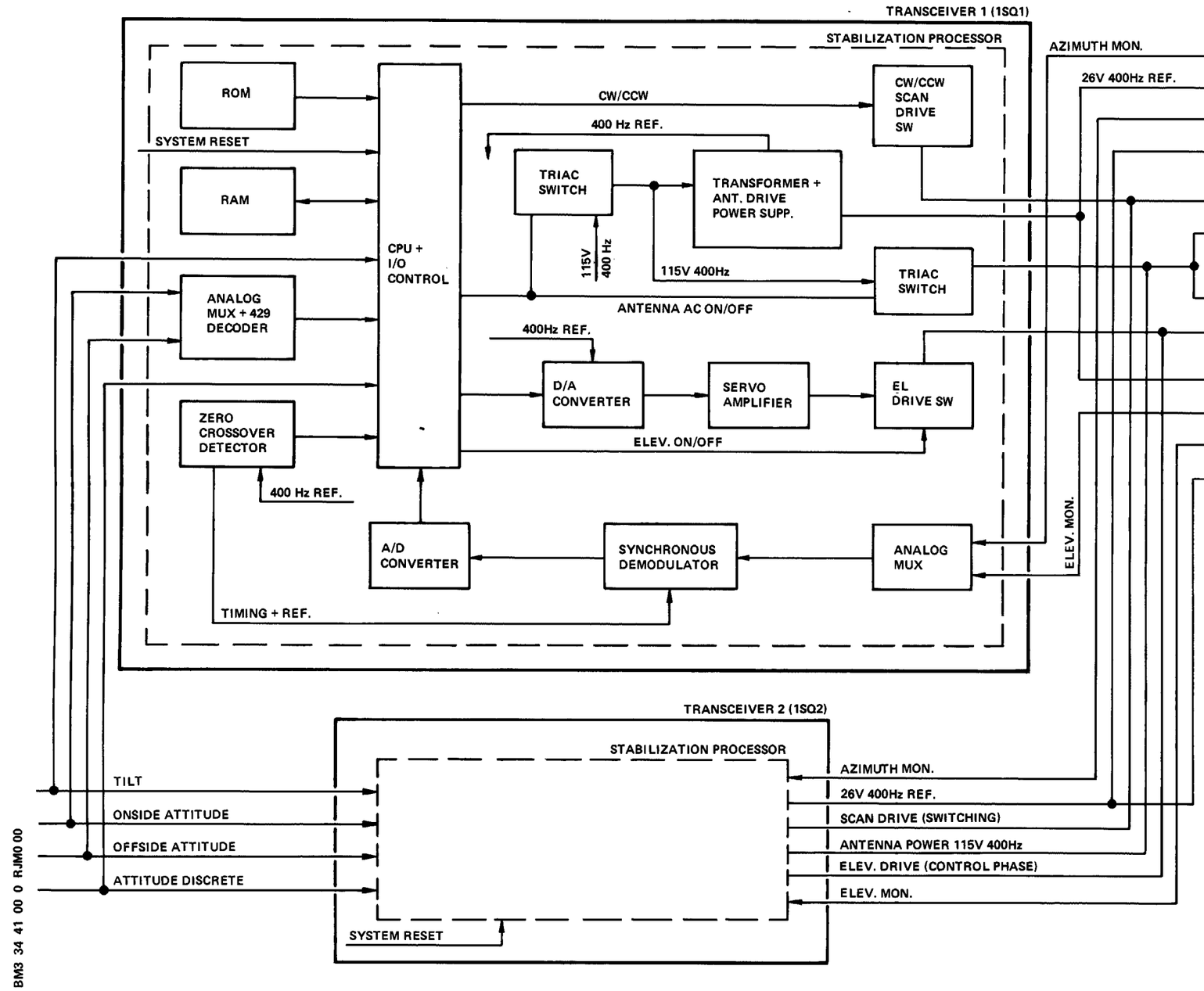
(a)Azimuth Drive System

The azimuth drive system develops the 180 degree oscillating motion, or scanning, of the antenna. The azimuth drive motor drives the antenna through a series of reduction gears to provide 15 scans (or looks) per minute over a 180 degree sector (90 degrees to either side of a straight ahead zero degree heading). The azimuth drive motor is a synchronous 115 V 400 Hz motor with dual windings to provide clockwise and counterclockwise rotation. The azimuth drive is an open loop operation.

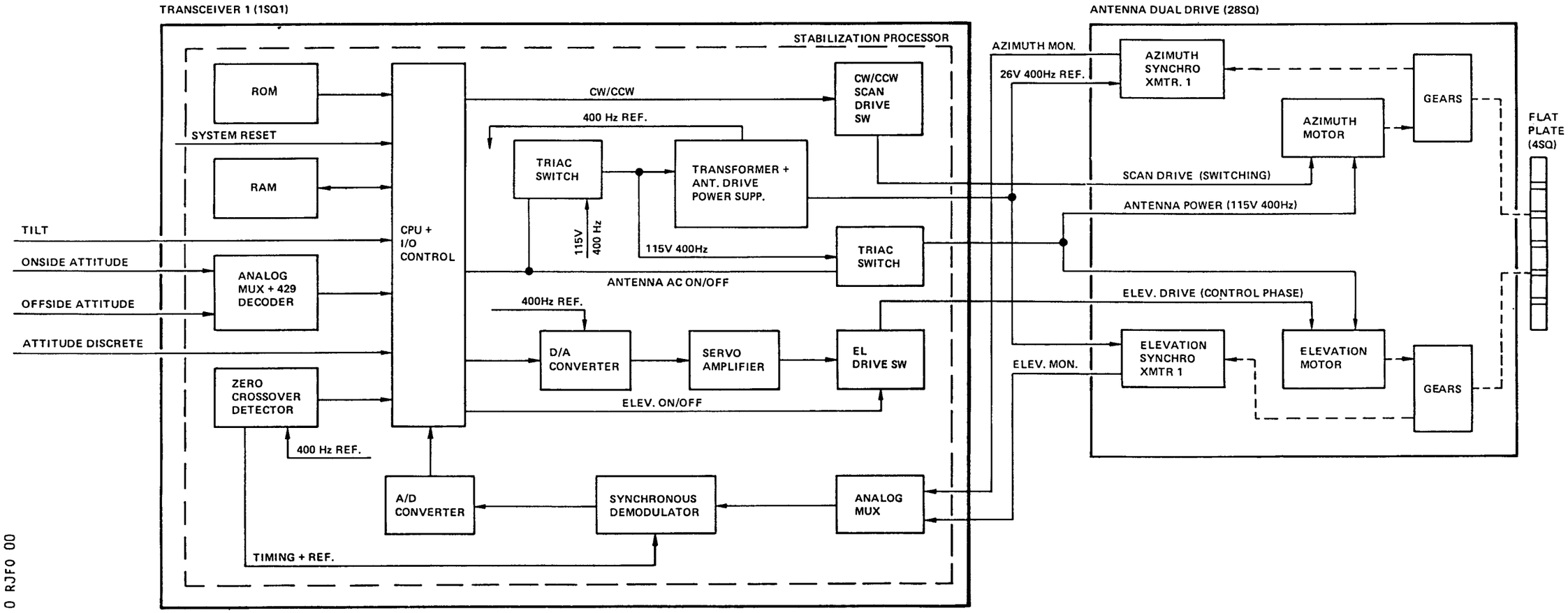
The antenna stabilization processor located in the TR unit monitors the azimuth angle of the antenna and generates the signals which are applied to the antenna circuitry to reverse the azimuth movement direction whenever the antenna reaches the left or right 90 degree position, as referenced to the straight-ahead zero-degree heading.

NOTE : The antenna scans the 180 degree sector straight ahead, but the EFIS (Ref. 34-71-00) uses information only from the sector - 60 degrees to + 60 degrees straight ahead.

Controlled by an triac switch of the stabilization processor in the TR unit, the 115 V drive signal is applied to one of the dual windings in the azimuth motor. The motor rotation drives the gear train, which in turn drives the antenna to one side of the straight ahead zero-degree heading. The azimuth synchro continuously transmits the antenna angle position to the stabilization processor. When the antenna reaches the 85 degree position, the microcomputer, through triac switching, removes the 115 V drive signal from the azimuth motor. The antenna continues to coast in the direction of its movement until the stabilization processor determines the antenna has reached 90 degrees, at which time the 115 V drive signal is applied to the other of the dual windings in the azimuth motor to drive the azimuth motor in the reverse direction. The antenna therefore is driven in the reverse direction, from the 90 degree angle position through the straight-ahead zero-degree position and toward the 90-degree angle position of



Antenna Drive - Block Diagram
Figure 018



BM6 34 41 00 0 RJF0 00

Antenna Drive - Block Diagram
Figure 019

the opposite side. The stabilization processor again removes the 115 V from the azimuth motor when the antenna position has reached 85 degrees and the antenna coasts to the 90-degree angle position. The stabilization processor applies the 115 V drive signal to the motor winding, which initiates reverse rotation each time the antenna position angle is 90 degrees, causing the antenna to constantly scan the 180-degree sector straight ahead.

(b)Azimuth Synchro Transmitter Function

The rotors of the azimuth synchro transmitters are geared to the azimuth drive system of the antenna; therefore the positions of the rotors follow the antenna movement. The gear ratio from the planar array to the synchro is 1.5:1. When the planar array is in the 90 degree position, the synchro angle is 135 degrees. A 26 V 400 Hz reference voltage, supplied by the TR unit, is applied to the rotor of synchro transmitter 1. The rotor of the synchro has only one winding. The stator has three windings 120 degrees apart. The synchro functions as a variable transformer in which the rotor is the primary and the stator windings are the secondaries. Voltages induced in the stator depend upon the relative position of the rotor with respect to the stator.

Therefore, the voltage induced in the stator electrically represents the position of the antenna in azimuth. The stator of SYNCHRO TRANSMITTER 1 provides proportional X, Y, and Z sine wave voltages which are processed using synchronous demodulator circuitry under the control of the stabilization processor in the TR unit.

Azimuth synchro transmitter 2 (used in system 2, dual installations) "rides along" when system 1 is in operation, although electrically, it is turned off. In turn, azimuth synchro transmitter 1 "rides along" when synchro transmitter 2 is operating electrically during system 2 operation.

(c)Elevation Drive System

The elevation drive motor is a two-phase servo motor which operates with a reference phase voltage of 115 V 400 Hz supplied to one winding, and a 400 Hz control phase voltage of varying amplitude (max. 36 V rms) applied to the other winding. The reference phase voltage is applied at all times while the control phase is applied only when needed to reposition the antenna planar array in elevation as ordered by the stabilization processor circuitry in the TR unit. The control voltage is an error voltage supplied an servo amplifier of the stabilization processor. The elevation motor repositions the antenna in elevation until the phase of the error voltage induced in the control winding reaches a null. The speed at which this correction is performed is dependent on the error voltage amplitude.

(d)Elevation Synchro Transmitter Function

The elevation synchro transmitters are geared to the elevation drive system of the antenna. They function in the same manner described for the azimuth synchro transmitters in para (b) except that the elevation voltage in the stators electrically represent the position of the antenna in elevation. Elevation synchro transmitter 2 (used in system 2, dual installations) "rides along" when system 1 is in operation, although electrically, it is turned off. In turn, elevation synchro transmitter 1 "rides along" when 2 is operating electrically during system 2 operation.

(e)Antenna Stabilization Processor

The antenna stabilization processor in the TR unit continuously computes the antenna line-of-sight stabilization from the aircraft pitch and roll attitudes, selected antenna tilt angle, antenna elevation angle, and antenna azimuth angle. It uses the computed antenna elevation-error signal to drive the antenna to the selected tilt angle and to stabilize the antenna line of sight. It generates from the computed azimuth angle a discrete signal which switches the azimuth motor to scan 180 degrees clockwise and counterclockwise. Besides the processor does a fault analysis of the antenna drive circuits, the antenna dual drive, and the pitch and roll gyro inputs.
The basic microcomputer of the stabilization processor consists of a microprocessor (CPU), an input/output control (I/O), a read-only memory (ROM), and a random access memory (RAM). The CPU is used for the computation of the antenna line of sight stabilization, the elevation-error signal, and the azimuth scan drive signal as well as the fault analysis. The I/O provides an interface between the CPU and the various circuits of the stabilization processor.
The ROM, used by the CPU, contains the firmware programs for the system initialization, the fault analysis, the interrupt and control routines and the formulas for the computations. The RAM provides a storage for all temporary variables used by the CPU.
After power-on, the CPU of the stabilization processor receives a system reset from the main computer (timing and control processor) of the TR and starts a system initialization routine. During this time the RAM is cleared and set up and the antenna ac on/off signals's is applied to two triac switches. One switch applies 115 V 400 Hz to the transformer and antenna drive power supply as well as to the second triac switch. The 115 V are converted by the transformer and applied as a 26 V 400 Hz reference to the azimuth and elevation synchro of the dual drive. The 115 V 400 Hz are also applied as antenna power to the motors of the dual drive.
At the end of the initialization routine, the CPU goes into a fault analysis routine. In this routine, it checks the antenna drive circuits, the processor circuits, the dual drive, and the pitch and roll gyro inputs. If no fault is detected, the stabilization processor starts the antenna drive routine.
Therefore, the processor receives the aircraft's digital attitude values. The values are applied as onside and offside attitude on high speed ARINC 429 control buses. The attitude discrete signal determines, if the onside or offside attitude is used for the computation. After multiplexing and decoding by a 429 decoder, the values are applied to the CPU together with the momentary tilt angle received from the weather radar control panel. Besides, the stabilization processor receives the elevation- and azimuth monitor signals from the antenna synchros. These signals, representing the actual antenna position in azimuth and elevation, are multiplexed and then demodulated with the help of a synchronous demodulator. The necessary timing signals for the demodulation as well as the 400 Hz reference are applied by a zero crossover detector. The demodulated synchro signals are converted into digital values and fed to the CPU.

The CPU computes the appropriate elevation-error drive signal from the calculated pitch and roll angles, the monitored elevation- and azimuth angle, and the selected tilt angle. The error drive signal is converted into a 400 Hz voltage by a D/A converter, amplified by a servo amplifier and fed through the closed elevation switch to drive the antenna elevation motor.
Through the I/O control, the CPU controls the antenna scan operation, by alternately turning on and off the CW/CCW scan drive (triac) switch. Every time the antenna reaches the plus or minus 90 degree limit, the scan drive switch reverses the scan direction by switching the 115 V antenna power to one of the dual windings of the azimuth motor.

E. Wave Guide Assembly

R **ON A/C 101-200,

R (a)Azimuth Drive System
R The azimuth drive system develops the 180 degree oscillating motion, or
R scanning, of the antenna. The azimuth drive motor drives the antenna
R through a series of reduction gears to provide 15 scans (or looks) per
R minute over a 180 degree sector (90 degrees to either side of a
R straight ahead zero degree heading). The azimuth drive motor is a syn-
R chronous 115 V 400 Hz motor with dual windings to provide clockwise
R and counterclockwise rotation. The azimuth drive is an open loop
R operation.
R The antenna stabilization processor located in the TR unit monitors
R the azimuth angle of the antenna and generates the signals which are
R applied to the antenna circuitry to reverse the azimuth movement
R direction whenever the antenna reaches the left or right 90 degree
R position, as referenced to the straight-ahead zero-degree heading.
R
R NOTE : The antenna scans the 180 degree sector straight ahead, but
R the EFIS (Ref. 34-71-00) uses information only from the sector
R - 60 degrees to + 60 degrees straight ahead.
R
R Controlled by an triac switch of the stabilization processor in the TR
R unit, the 115 V drive signal is applied to one of the dual windings
R in the azimuth motor. The motor rotation drives the gear train, which
R in turn drives the antenna to one side of the straight ahead zero-
R degree heading. The azimuth synchro continuously transmits the antenna
R angle position to the stabilization processor. When the antenna reaches
R the 85 degree position, the microcomputer, through triac switching,
R removes the 115 V drive signal from the azimuth motor. The antenna
R continues to coast in the direction of its movement until the
R stabilization processor determines the antenna has reached 90 degrees,
R at which time the 115 V drive signal is applied to the other of the
R dual windings in the azimuth motor to drive the azimuth motor in the
R reverse direction. The antenna therefore is driven in the reverse
R direction, from the 90 degree angle position through the straight-
R ahead zero-degree position and toward the 90-degree angle position of
R the opposite side. The stabilization processor again removes the 115 V

R from the azimuth motor when the antenna position has reached 85 degrees
R and the antenna coasts to the 90-degree angle position. The stabiliza-
R tion processor applies the 115 V drive signal to the motor winding,
R which initiates reverse rotation each time the antenna position
R angle is 90 degrees, causing the antenna to constantly scan the 180-
R degree sector straight ahead.

R (b)Azimuth Synchro Transmitter Function
R The rotors of the azimuth synchro transmitters are geared to the
R azimuth drive system of the antenna; therefore the positions of the
R rotors follow the antenna movement. The gear ratio from the planar
R array to the synchro is 1.5:1. When the planar array is in the 90
R degree position, the synchro angle is 135 degrees. A 26 V 400 Hz
R reference voltage, supplied by the TR unit, is applied to the rotor
R of synchro transmitter 1. The rotor of the synchro has only one
R winding. The stator has three windings 120 degrees apart. The synchro
R functions as a variable transformer in which the rotor is the primary
R and the stator windings are the secondaries. Voltages induced in the
R stator depend upon the relative position of the rotor with respect
R to the stator.
R Therefore, the voltage induced in the stator electrically represents
R the position of the antenna in azimuth. The stator of SYNCHRO TRANS-
R MITTER 1 provides proportional X, Y, and Z sine wave voltages which
R are processed using synchronous demodulator circuitry under the
R control of the stabilization processor in the TR unit.
R (c)Elevation Drive System
R The elevation drive motor is a two-phase servo motor which operates
R with a reference phase voltage of 115 V 400 Hz supplied to one winding,
R and a 400 Hz control phase voltage of varying amplitude (max. 36 V rms)
R applied to the other winding. The reference phase voltage is applied
R at all times while the control phase is applied only when needed to
R reposition the antenna planar array in elevation as ordered by the
R stabilization processor circuitry in the TR unit. The control voltage
R is an error voltage supplied an servo amplifier of the stabilization
R processor. The elevation motor repositions the antenna in elevation
R until the phase of the error voltage induced in the control winding
R reaches a null. The speed at which this correction is performed is
R dependent on the error voltage amplitude.
R (d)Elevation Synchro Transmitter Function
R The elevation synchro transmitters are geared to the elevation drive
R system of the antenna. They function in the same manner described for
R the azimuth synchro transmitters in para (b) except that the elevation
R voltage in the stators electrically represent the position of the
R antenna in elevation.

R (e)Antenna Stabilization Processor

R The antenna stabilization processor in the TR unit continuously computes the antenna line-of-sight stabilization from the aircraft pitch and roll attitudes, selected antenna tilt angle, antenna elevation angle, and antenna azimuth angle. It uses the computed antenna elevation-error signal to drive the antenna to the selected tilt angle and to stabilize the antenna line of sight. It generates from the computed azimuth angle a discrete signal which switches the azimuth motor to scan 180 degrees clockwise and counterclockwise. Besides the processor does a fault analysis of the antenna drive circuits, the antenna dual drive, and the pitch and roll gyro inputs.

R The basic microcomputer of the stabilization processor consists of a microprocessor (CPU), an input/output control (I/O), a read-only memory (ROM), and a random access memory (RAM). The CPU is used for the computation of the antenna line of sight stabilization, the elevation-error signal, and the azimuth scan drive signal as well as the fault analysis. The I/O provides an interface between the CPU and the various circuits of the stabilization processor.

R The ROM, used by the CPU, contains the firmware programs for the system initialization, the fault analysis, the interrupt and control routines and the formulas for the computations. The RAM provides a storage for all temporary variables used by the CPU.

R After power-on, the CPU of the stabilization processor receives a system reset from the main computer (timing and control processor) of the TR and starts a system initialization routine. During this time the RAM is cleared and set up and the antenna ac on/off signals's is applied to two triac switches. One switch applies 115 V 400 Hz to the transformer and antenna drive power supply as well as to the second triac switch. The 115 V are converted by the transformer and applied as a 26 V 400 Hz reference to the azimuth and elevation synchro of the dual drive. The 115 V 400 Hz are also applied as antenna power to the motors of the dual drive.

R At the end of the initialization routine, the CPU goes into a fault analysis routine. In this routine, it checks the antenna drive circuits, the processor circuits, the dual drive, and the pitch and roll gyro inputs. If no fault is detected, the stabilization processor starts the antenna drive routine.

R Therefore, the processor receives the aircraft's digital attitude values. The values are applied as onside and offside attitude on high speed ARINC 429 control buses. The attitude discrete signal determines, if the onside or offside attitude is used for the computation. After multiplexing and decoding by a 429 decoder, the values are applied to the CPU together with the momentary tilt angle received from the weather radar control panel. Besides, the stabilization processor receives the elevation- and azimuth monitor signals from the antenna synchros. These signals, representing the actual antenna position in azimuth and elevation, are multiplexed and then demodulated with the help of a synchronous demodulator. The necessary timing signals for the demodulation as well as the 400 Hz reference are applied by a zero crossover detector. The demodulated synchro signals are converted into digital values and fed to the CPU.

R The CPU computes the appropriate elevation-error drive signal from
R the calculated pitch and roll angles, the monitored elevation- and
R azimuth angle, and the selected tilt angle. The error drive signal
R is converted into a 400 Hz voltage by a D/A converter, amplified by
R a servo amplifier and fed through the closed elevation switch to
R drive the antenna elevation motor.
R Through the I/O control, the CPU controls the antenna scan operation,
R by alternately turning on and off the CW/CCW scan drive (triac) switch.
R Every time the antenna reaches the plus or minus 90 degree limit,
R the scan drive switch reverses the scan direction by switching the
R 115 V antenna power to one of the dual windings of the azimuth motor.

R E. Wave Guide Assembly

R **ON A/C 001-100,

(Ref. Fig. 020)

R **ON A/C 101-200,

R (Ref. Fig. 021)

R **ON A/C ALL

The wave guide assembly provides the RF connection between the transceiver and antenna assembly.
The wave guide assembly is made up of mechanically formed brass tubes without solder joints as waveguide sections which provide flexibility whilst maintaining resistance to vibration. The sections are rectangular (0.5 in. x 1 in.) as necessary for 3 cm wavelengths.

F. Transceiver Shockmount (11SQ)

R **ON A/C 001-100,

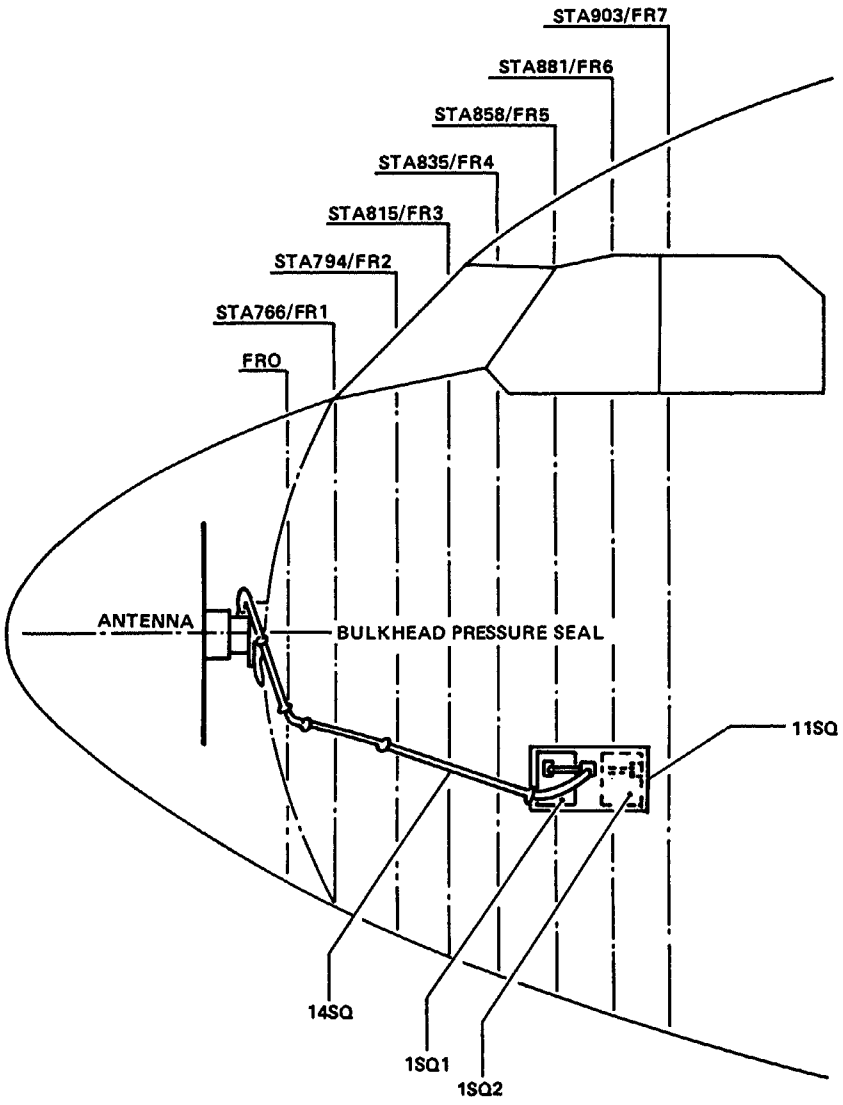
(Ref. Fig. 022)

R **ON A/C 101-200,

R (Ref. Fig. 023)

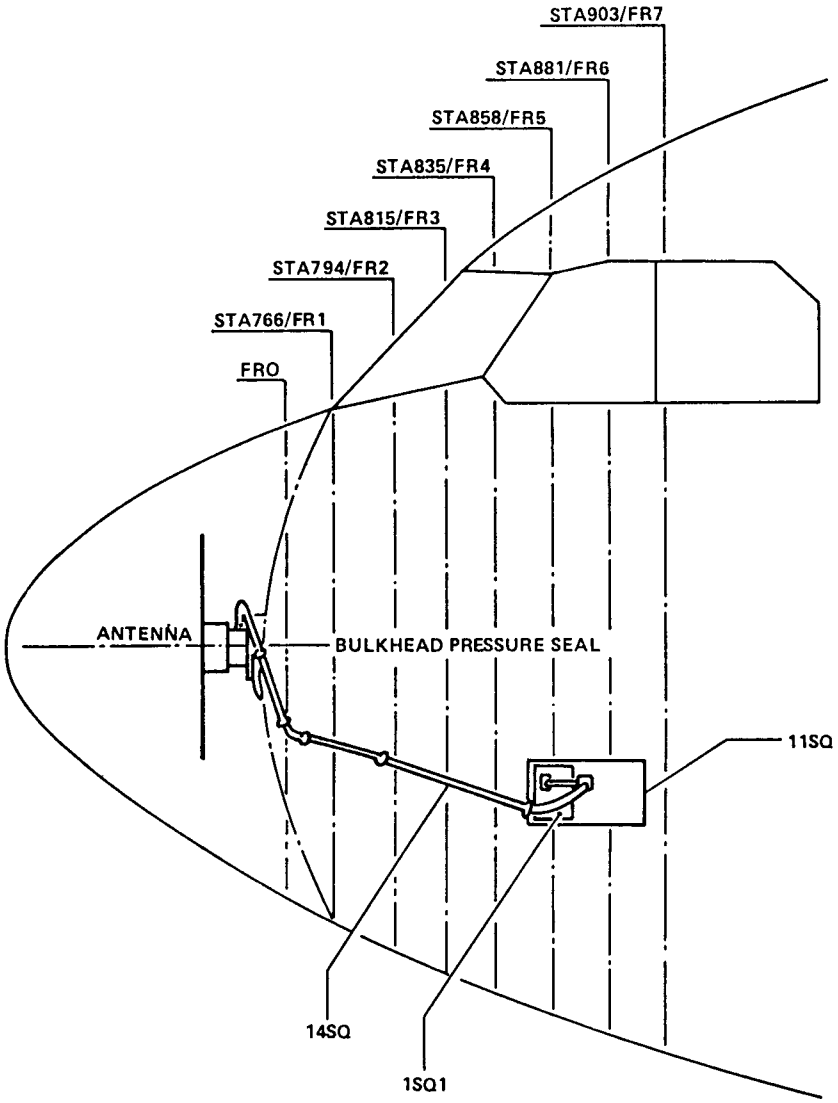
R **ON A/C 001-100,

(1)Description
The transceiver dual shockmount is fitted with all electrical and wave guide connections required by two transceivers. The wave guide switch is an integral part of the mount. Three polarizing pins help guide the transceiver into the mount, thus preventing damage to the connector pins, and ensure that only the correct transceiver can be fitted.
Cooling air for the transceiver is provided from the aircraft air conditioning, to ARINC 600 specifications (Ref. 21-20-00).



BM3 34 41 00 0 RLM0 00

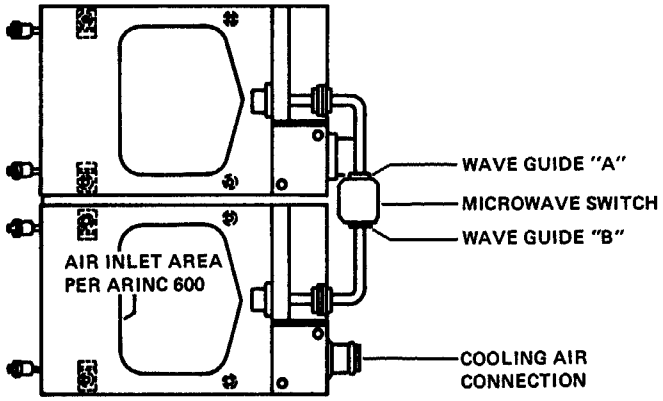
Wave Guide Assembly
Figure 020

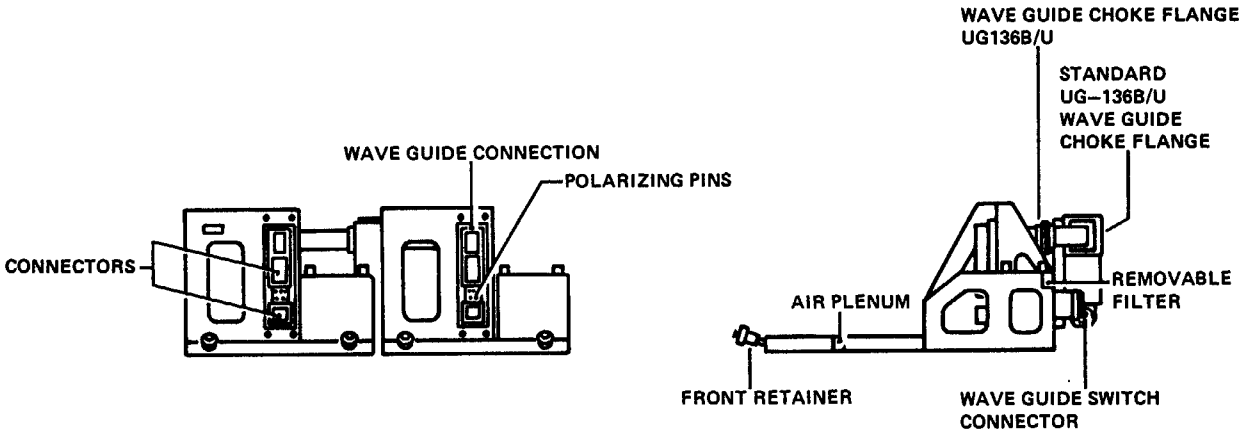


BM6 34 41 00 0 RLF0 00

R

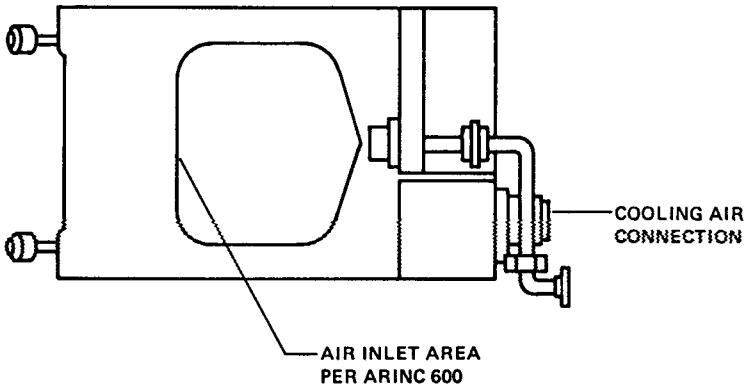
Wave Guide Assembly
Figure 021

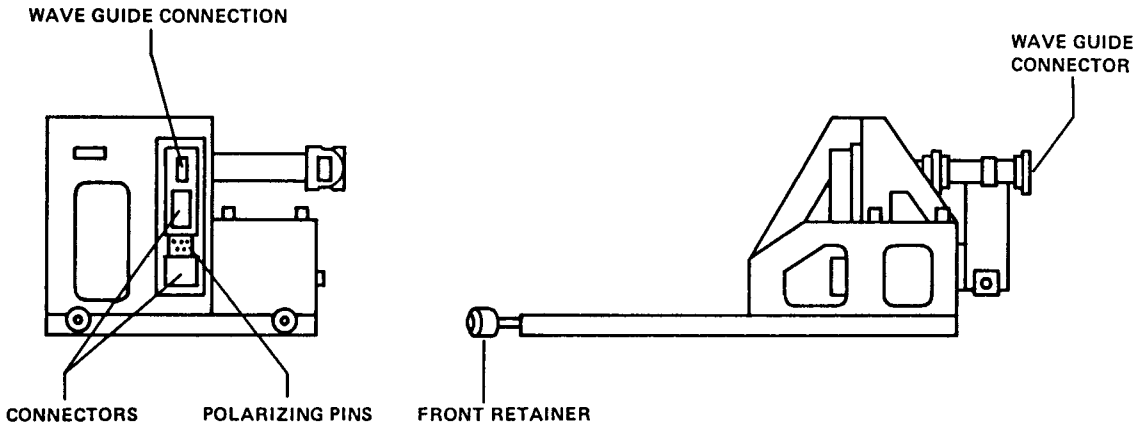




BM3 34 41 00 0 RNM0 00

Transceiver Shockmount
Figure 022





BM6 34 41 00 0 RNF0 00

R Transceiver Shockmount
Figure 023

If only one transceiver is fitted, wave guide outlet B must be blanked off.

(2)Specifications

Weight	9.8 lb. (4.4 kg)
Length	18.46 ±0.2 in. (468.88 ±5.08 mm)
Height	8.38 in. max. (212.85 mm)
Width	21.00 ±0.2 in. (533.40 ±5.08 mm)
Cooling	ARINC 600
Form Factor	8 MCU, ARINC 708
Power Requirements	28 V DC (for waveguide switch)

5. System Operation

R **ON A/C 101-200,

R (1)Description
R The transceiver single shockmount is fitted with all electrical and
R wave guide connections for the transceiver.
R A wave guide connection assembly is an integral part of the mount and
R connects the transceiver to the aircraft mounted parts of the wave guide
R assembly. Three polarizing pins help guide the transceiver into the
R mount, thus preventing damage to the connector pins, and ensure that only
R the correct transceiver can be fitted. Cooling air for the transceiver is
R provided from the aircraft air conditioning, to ARINC 600 specifications
R (Ref. 21-20-00).
R (2)Specifications

R Weight	3.3 lb. (1.5 kg)
R Length	18.46 ±0.2 in. (468.88 ±5.08 mm)
R Height	8.38 in. max. (212.85 mm)
R Width	10.21 ±0.2 in. (259.33 ±5.08 mm)
R Cooling	ARINC 600
R Form Factor	ARINC 708

R 5. System Operation

R **ON A/C 001-100,

(Ref. Fig. 024)

R **ON A/C 101-200,

R (Ref. Fig. 025)

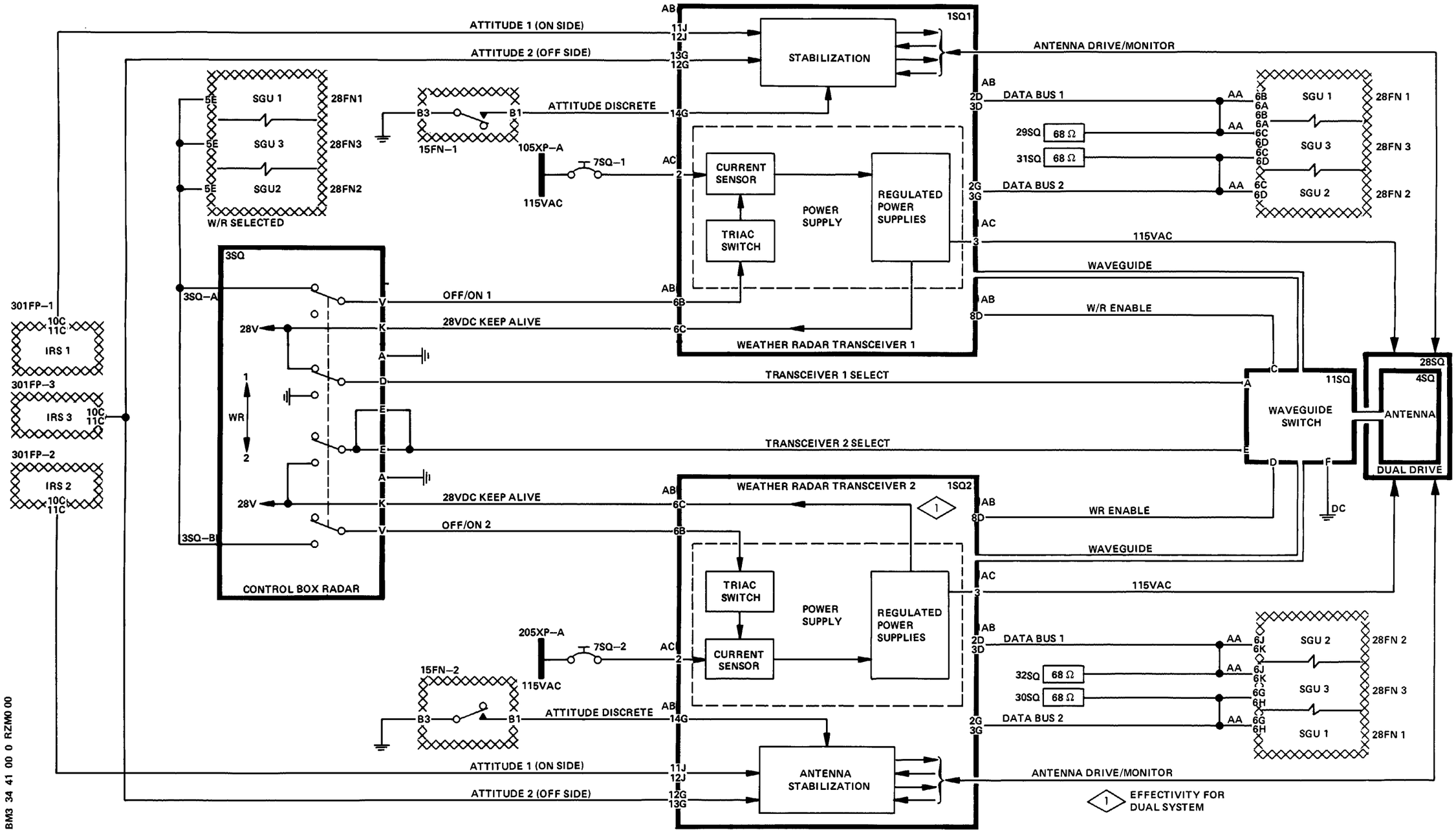
R **ON A/C 001-100,

(Ref. Fig. 026)

R **ON A/C 101-200,

R (Ref. Fig. 027)

INTENTIONALLY BLANK



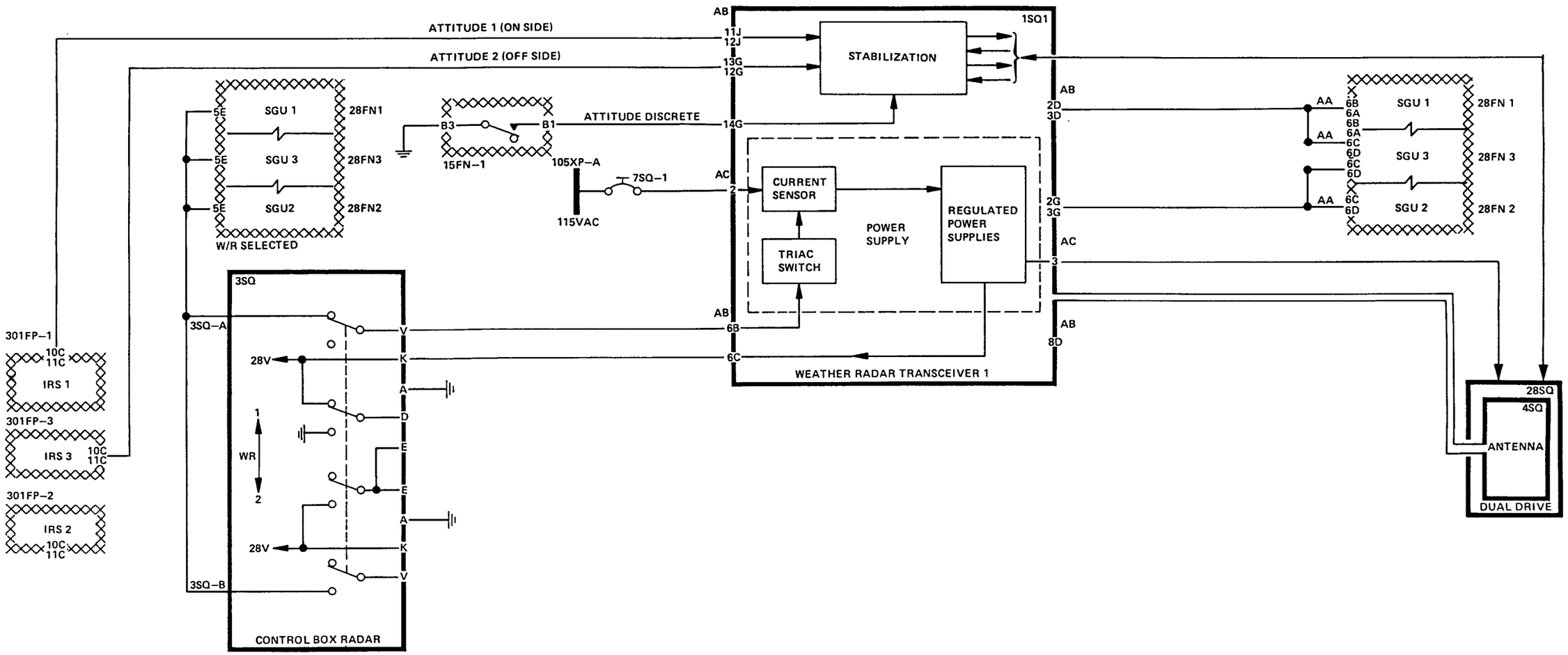
BM3 34 41 00 0 RZM0 00

Simplified Schematic
Figure 024

EFFECTIVITY: 001-100,

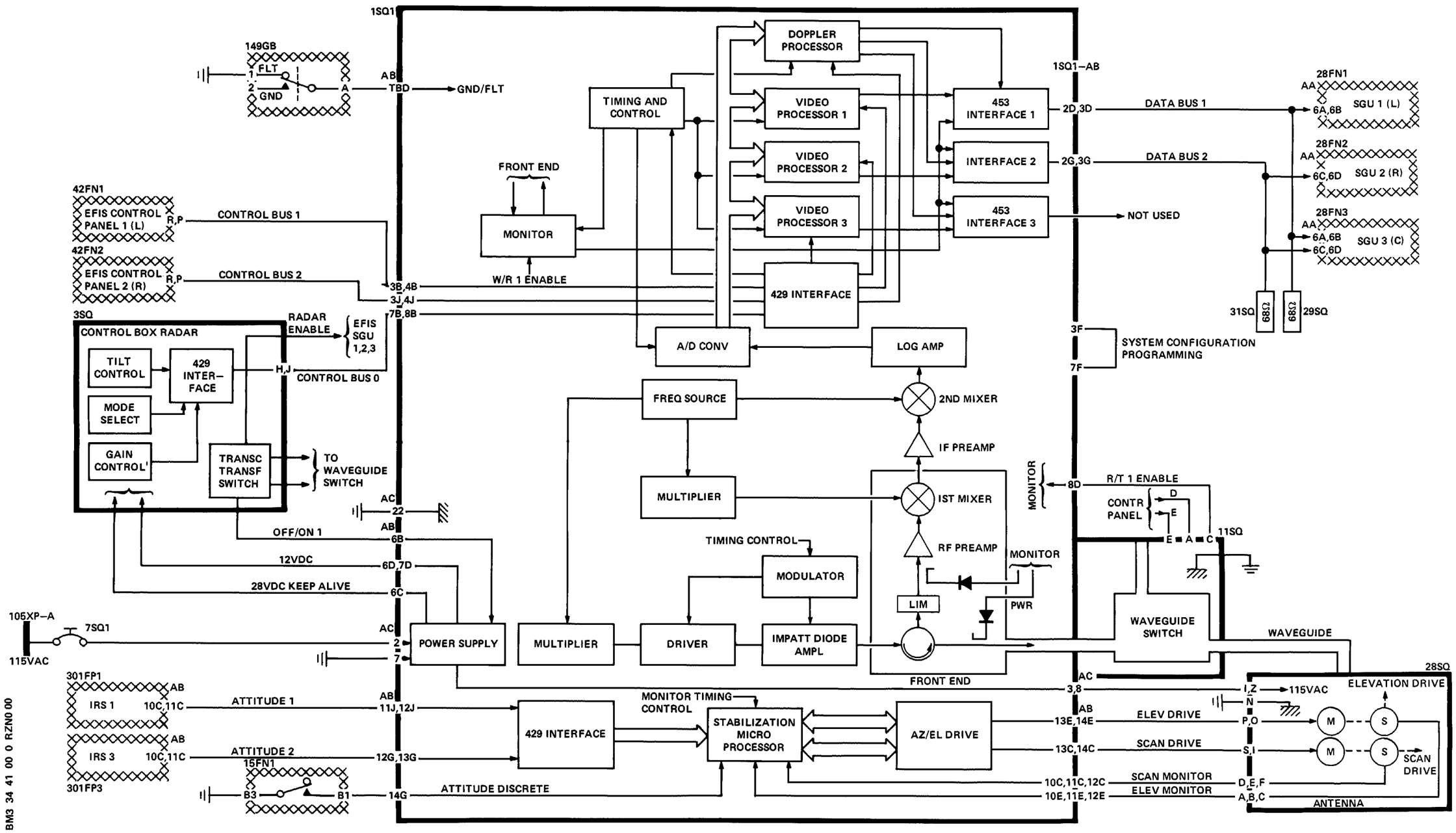
PIA

Printed in France

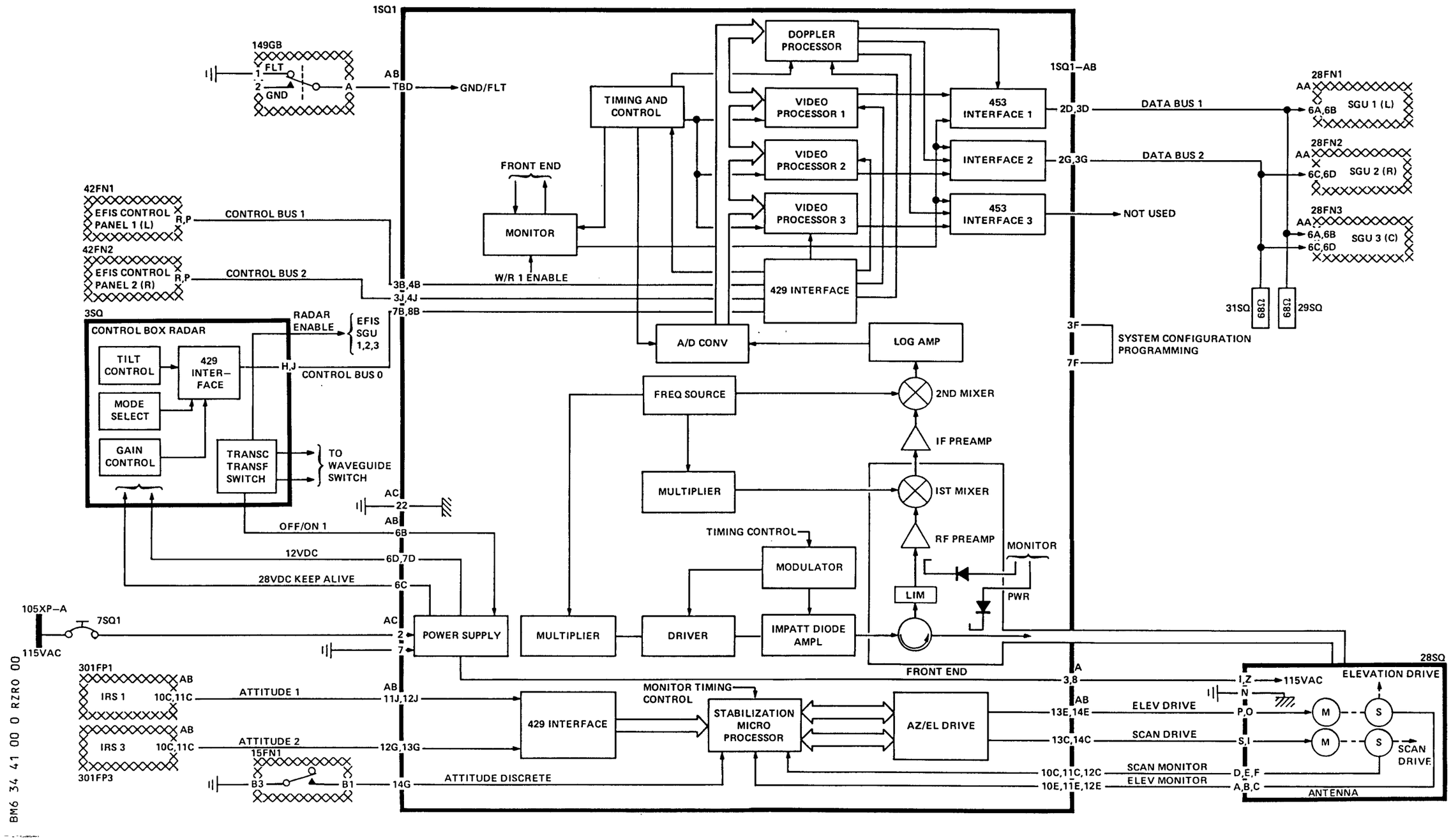


BM6 34 41 00 O RZFO 00

Simplified Schematic
Figure 025



Weather Radar Schematic
Figure 026



Weather Radar Schematic
Figure 027

R

R **ON A/C ALL

The weather radar system must be operated in conjunction with the EFIS (Ref. 34-71-00).
Operational requirements are as follows:
- aircraft electrical network energized
- aircraft attitude system operational (Ref. 34-20-00)

- EFIS in operational mode (34-71-00)
- EFIS control panel 42FN1 (42FN2) set to MAP or ARC

R **ON A/C 101-200,

- Control Box Radar (3SQ) SYS1/OFF/SYS2 switch to SYS1.
  NOTE : Position SYS2 is not active!

R **ON A/C 001-100,

- Control Box Radar (3SQ) SYS1/OFF/SYS2 switch to SYS1 or SYS2.

R **ON A/C ALL

The regulated power supply in the transceiver now supplies all the transceiver circuits, and the system operates.
Control word 1 from the weather radar control panel, and control word 2 from either or both EFIS control panels are addressed to the transceiver on ARINC 429 control bus.
After good parity checks, the antenna is driven to the correct scan angle, and stabilized to the aircraft principal axis.
9345 MHz RF pulses are transmitted via the wave guide and antenna assemblies.
The transceiver converts any reflected RF signals to digital range and intensity precipitation data, which is addressed to the EFIS SGUs on two ARINC 453 data bus.
The EFIS displays the weather data on the Navigation Display, using colors to define precipitation intensity:

COLOR	PRECIPITATION	RETURN LEVEL dBZ	APPROXIMATE RAINFALL LEVEL mm/Hour	Inches/Hour
Black	Low	< 20 dBZ	< 1	< 0.04
Green	Light	20 to 30 dBZ	1 to 4	0.04 to 0.16
Yellow	Medium	30 to 40 dBZ	4 to 12	0.16 to 0.47
Red	Heavy	> 40 dBZ	> 12	> 0.47
Magenta	Very heavy and turbulence detection overlay	> 45 dBZ	> 45	

Messages showing any irregularities or failures of the WR system during operation appear on the lower right hand side of the navigation display (Ref. 34-75-00).
Two types of information are given:
(a)Failures causing loss of weather radar image.

(b)Failures which do not cause loss of weather radar image. If more than one failure causing loss of image occurs, only the highest priority message is displayed.

FAILURE/ ERROR	PRIORITY	MESSAGE	COLOR
TRANSMITTER FAIL	1	WR	RED
		T-R	RED
ANTENNA FAIL	2	WR	RED
		ANT	RED
CONTROL ERROR	3	WR	RED
		CTL	RED
RANGE ERROR	4	WR	RED
		RNG	RED

Should a failure not causing loss of weather radar image occur, the appropriate message will appear. Should a loss of image failure subsequently occur, the loss of image failure will take priority.

DEFECT/INCIDENT	MESSAGE	COLOR
CALIBRATION DEFECT	WR	AMBER
	WEAK	AMBER
ATTITUDE SIGNAL	WR	AMBER
DEFECT	ATT	AMBER
TEST MODE	WR	AMBER
	TEST	AMBER
RANGE SCALE CHANGE	RANGE	AMBER
(SMALL TIME INTERVAL	CHANGE	AMBER
BEFORE NEW IMAGE)		
WX OR MAP OPERATION	TILT	AMBER
(TILT ANGLE IN	X.X	AMBER
0.5 STEPS)		

6. Test

A. System Test

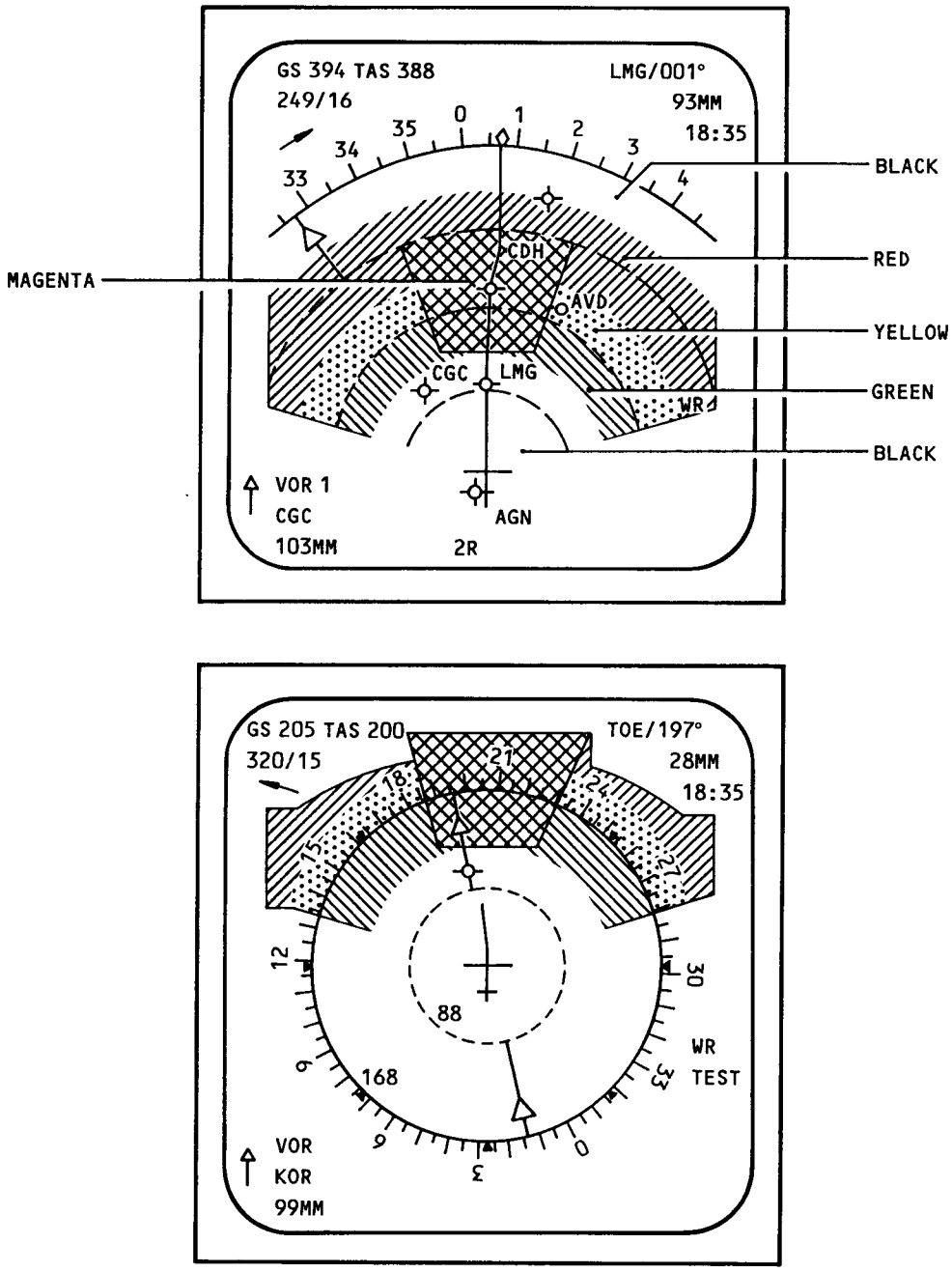
During system operation, a test function can be performed. During test, the weather radar operates normally, except that a firmware-programmed data word is substituted in place of the actual weather data.
(Ref. Fig. 028)
Setting the mode selector on radar control box to TEST position causes the test word to be generated.
A test pattern, together with the message WR TEST appears on the Navigation Display.

B. Built-in Test

(Ref. Fig. 006)

During each 5.25 millisecond period of a transmitter/receiver operation, built-in tests provide qualitative checks of the principal functional circuits of the transceiver. Through the monitoring circuits, the timing and control circuits monitor qualitative test parameters from the hardware to determine whether the transceiver, the IRS inputs and the waveguide switch are operating satisfactorily or whether a fault condition is present. The antenna drive and control unit are similarly monitored. All detected failures are stored in a 1K x 4-bit non-volatile ROM fault memory and visually indicated by LEDs on the front panel of the transceiver.
Pressing, and holding depressed, the TEST pushbutton switch on the transceiver front panel will cause all of the LEDs to momentarily come on. Lamps which remain on are indicative of a detected and stored failure. The following failures are indicated by the LEDs:

LED	FAILURE
R/T	Transmitter power output Transmitter modulator x9 multiplier. Frequency sources RF pre-amplifier and receiver section Video processor and memory 453 data busses.
ANT	Antenna stabilization and drive Antenna unit
IND	Not used in this application
CON	Transceiver control unit
WG SW	Waveguide switch
GYRO	IRS inputs
AIR	Transceiver cooling and over-temperature.



BM6 34 41 00 0 RZXO 01

Weather Radar Test Pattern
Figure 028

The fault memory, which will store up to a maximum of 127 failures, will, when full of coded fault conditions, replace the earliest recorded failures with the latest current failures thereby ensuring that the most recent failures are recorded.

7. Interfaces

The weather radar system receives aircraft attitude information from the IRS (34-45-00) on ARINC 429 busses for use in computing antenna line of sight stabilization.

Cooling for the transceiver is provided as specified in ARINC characteristic 600.

R 1. Operational Test

A. Reason for the Job
This operational test procedure is designed to verify the operating function of the Weather Radar System after the replacement of any component during flight line maintenance. Adjustment of the system at this stage is not applicable.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Circuit Breaker Safety Clips and Tags

Referenced Procedures

- 21-21-00, P. Block 1	Air Conditioning - Distribution/Extraction
- 24-41-00, P. Block 301	AC External Power Control
- 34-71-00, P. Block 501	EFIS General

C. Job Set-Up

WARNING : DUE TO THE RISK OF INJURY TO PERSONNEL OR DAMAGE TO THE EQUIPMENT WHEN THE TRANSCEIVER IS TRANSMITTING, THE FOLLOWING PRECAUTIONS MUST BE OBSERVED.
- NO-ONE MAY STAND IN FRONT OF THE ANTENNA AT A DISTANCE OF LESS THAN 5 METERS WITHIN AN ARC OF ±135° OF THE AIRCRAFT CENTERLINE.
(THE DANGER IS EVEN GREATER WHEN THE ANTENNA IS NOT SCANNING).
- DO NOT LOOK INTO THE WAVEGUIDE WHEN THE TRANSCEIVER IS OPERATING.
- NO REFUELING OPERATIONS MAY BE CARRIED OUT WITHIN THE VICINITY OF THE AIRCRAFT.
- MAINTAIN A MINIMUM SAFETY DISTANCE OF 5 METERS BETWEEN THE AIRCRAFT AND ANY METALLIC OBJECT WITHIN AN ARC OF ±90° OF THE AIRCRAFT CENTERLINE.
R - THE AIRCRAFT MUST NOT BE IN A HANGAR OR CLOSED AREA.

WARNING : THE HIGH VOLTAGES AND FREQUENCIES REQUIRED FOR WEATHER RADAR OPERATION FORBID ANY INTERFERENCE WITH THIS EQUIPMENT WHEN IT IS ENERGIZED.

**ON A/C 001-100,

(1)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(2)Make certain that forward services ventilation is operating (Ref. 21-21-00, P. Block 1).
(3)On weather radar control panel 3SQ make certain that:
- WR switch is set to OFF
- TILT selector switch is set to 0 position.
(4)Make certain that the following circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION CAPT EFIS ND	37FN1	104/F1
21VU	NAVIGATION CAPT EFIS CTL PNL	43FN1	104/F3
21VU	NAVIGATION CAPT EFIS SGU 1	30FN1	104/F4
21VU	NAVIGATION EFIS SGU 3	30FN3	104/F6
21VU	NAVIGATION F/O EFIS SGU 2	30FN2	104/F11
21VU	NAVIGATION F/O EFIS CTL PNL	43FN2	104/F12
21VU	NAVIGATION F/O EFIS ND	37FN2	104/F14
21VU	RADAR TR 1	7SQ1	107/C6
21VU	RADAR TR 2	7SQ2	107/C9
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/ IRS 3/115VAC	313FP1	208/B21
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/ IRS 1/115 VAC	312FP1	208/B22

(5)Switch on the EFIS (Ref. 34-71-00, P. Block 501).

D. Test

R **ON A/C 101-200,

R (1)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
R (2)Make certain that forward services ventilation is operating (Ref. 21-21-00, P. Block 1).
R (3)On weather radar control panel 3SQ make certain that:
R - SYS1/OFF/SYS2 switch is set to OFF
R - TILT selector switch is set to 0 position.
R (4)Make certain that the following circuit breakers are closed:

R	PANEL	SERVICE	IDENT.	LOCATION
R	21VU	NAVIGATION CAPT EFIS ND	37FN1	104/F1
R	21VU	NAVIGATION CAPT EFIS CTL PNL	43FN1	104/F3
R	21VU	NAVIGATION CAPT EFIS SGU 1	30FN1	104/F4
R	21VU	NAVIGATION EFIS SGU 3	30FN3	104/F6
R	21VU	NAVIGATION F/O EFIS SGU 2	30FN2	104/F11
R	21VU	NAVIGATION F/O EFIS CTL PNL	43FN2	104/F12
R	21VU	NAVIGATION F/O EFIS ND	37FN2	104/F14
R	21VU	RADAR TR 1	7SQ1	107/C6
R	22VU	MIN EQPT BAY SUPPLY/NAVIGATION/ IRS 3/115VAC	313FP1	208/B21
R	22VU	MIN EQPT BAY SUPPLY/NAVIGATION/ IRS 1/115 VAC	312FP1	208/B22

R (5)Switch on the EFIS (Ref. 34-71-00, P. Block 501).

R D. Test

R **ON A/C ALL

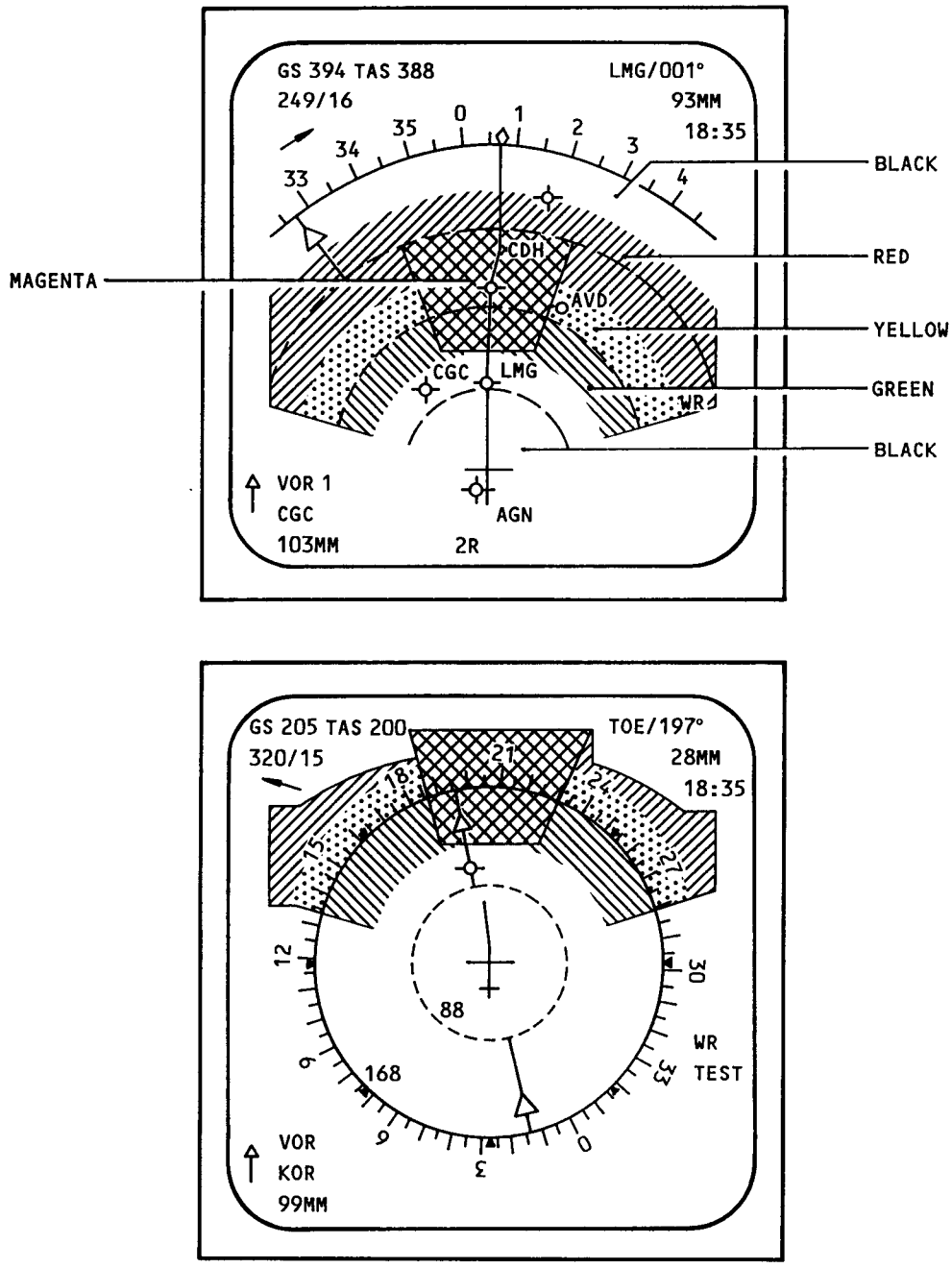
(Ref. Fig. 501)

R **ON A/C 001-100,

NOTE : The subsequent test procedure refers to WR1; to do the same test for WR2 refer to the references between the parentheses.

ACTION	RESULT
1. On Overhead Panel:	
- MSU1 (MSU2) selector switch to ATT or to NAV position.	Wait minimum period of 10 seconds - attitude signal available.
2. On Capt's and FO's EFIS Control Panel:	
- Mode selector switch to ARC or MAP.	On both Navigational displays ARC or MAP image is displayed.
- Range selector switch to desired range.	Selected range is displayed.
3. On Weather Radar Control Panel 3SQ:	
- switch to SYS 1 (2).	Weather Radar image is shown on both displays.
4. On Weather Radar Control Panel 3SQ:	
- Set GAIN to AUTO.	
- Set mode selector switch to TEST.	Test pattern as depicted in Fig. 501 is shown on both displays.
- Set mode selector switch to WX.	Test pattern is replaced with Weather Radar image on both displays.
- Set mode selector switch to MAP.	Observe that corresponding alpha-numerics appear on EFIS display for each position (TEST, WX and MAP) of the switch.
- Set mode selector switch to TURB.	Observe that corresponding alpha-numerics appear on EFIS display (TURB).
5. Do again steps 1 thru 4 to test the WR2 system.	

R **ON A/C 101-200,



BM6 34 41 00 5 MCMO 00

Weather Radar Test Pattern
Figure 501

R

ACTION	RESULT
1. On Overhead Panel:	
- MSU1 selector switch to ATT	Wait minimum period of 10 seconds - attitude signal available.
2. On Capt's and FO's EFIS Control Panel:	
- Mode selector switch to ARC or MAP	On both Navigational displays ARC or MAP image is displayed.
- Range selector switch to desired range.	Selected range is displayed.
3. On Weather Radar Control Panel 3SQ:	
- switch to SYS 1	Weather Radar image is shown on both displays.
4. On Weather Radar Control Panel 3SQ:	
- Set GAIN to AUTO	
- Set mode selector switch to TEST	Test pattern as depicted in Fig. 501 is shown on both displays.
- Set mode selector switch to WX	Test pattern is replaced with Weather Radar image on both displays.
- Set mode selector switch to MAP	Observe that corresponding alpha-numerics appear on EFIS display for each position (TEST, WX and MAP) of the switch.
- Set mode selector switch to TURB	Observe that corresponding alpha-numerics appear on EFIS display (TURB).

**ON A/C 001-100,

E. Close-Up
(1)On Weather Radar Control Panel 3SQ set WR switch to OFF.
(2)On Overhead Panel set MSU1 selector switch to OFF.
(3)Switch off the EFIS (Ref. 34-71-00, P. Block 501).
(4)De-energize the aircraft electrical network and disconnect electrical ground power unit (Ref. 24-41-00, P. Block 301).

**ON A/C 101-200,

E. Close-Up
(1)On Weather Radar Control Panel 3SQ set SYS1/OFF/SYS2 switch to OFF.
(2)On Overhead Panel set MSU1 selector switch to OFF.
(3)Switch off the EFIS (Ref. 34-71-00, P. Block 501).
(4)De-energize the aircraft electrical network and disconnect electrical ground power unit (Ref. 24-41-00, P. Block 301).

R **ON A/C 001-100,

2. System Test

A. Reason for the Job
(1)Test of Weather Radar interface with IRS and SGU3.
(2)Check of antenna control function.
(3)Test of Weather Radar transceiver.

B. Equipment and Materials
Referenced Procedures

- 21-20-00, P. Block 301	Air Conditioning - Distribution/Extraction
- 24-41-00, P. Block 301	AC External Power Control
- 34-41-00, P. Block 1	Weather Radar
- 34-71-00, P. Block 501	EFIS

C. Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT CIRCUITS UPON WHICH WORK IS TO BE PERFORMED ARE ISOLATED.

WARNING : DUE TO THE RISK OF INJURY TO PERSONNEL OR DAMAGE TO THE EQUIPMENT WHEN THE TRANSCEIVER IS TRANSMITTING, THE FOLLOWING PRECAUTIONS MUST BE OBSERVED:
- NO-ONE MAY STAND IN FRONT OF THE ANTENNA AT A DISTANCE OF LESS THAN 5 METERS WITHIN AN ARC OF ± 135° OF THE AIRCRAFT CENTERLINE. (THE DANGER IS EVEN GREATER WHEN THE ANTENNA IS NOT SCANNING).
- DO NOT LOOK INTO THE WAVEGUIDE WHEN THE TRANSCEIVER IS OPERATING.
- NO RE-FUELING OPERATIONS MUST BE CARRIED OUT WITHIN THE VICINITY OF THE AIRCRAFT.
- MAINTAIN A MINIMUM SAFETY DISTANCE OF 5 METERS BETWEEN THE AIRCRAFT AND ANY METALLIC OBJECT WITHIN AN ARC OF ± 90° OF THE AIRCRAFT CENTERLINE.

WARNING : THE HIGH VOLTAGES AND FREQUENCIES REQUIRED FOR WEATHER RADAR OPERATION FORBID ANY INTERFERENCE WITH THIS EQUIPMENT WHEN IT IS ENERGIZED.

(1)Connect the electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(2)Make certain that the forward services ventilation is operating (Ref. 21-20-00, P. Block 301).
(3)On weather radar control panel 11VU make certain that:
- the SYS 1/OFF/2 switch or the mode selector switch is set to OFF.
- the TILT selector switch is set to 0 position.
(4)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADAR TR 1	7SQ1	107/C6
21VU	RADAR TR 2	7SQ2	107/C9

(5)Open the radome.
NOTE : Two persons are required to open the radome.
CAUTION : ENSURE THAT THE RADOME SUPPORT STAYS ARE CORRECTLY LOCKED.
(6)Close circuit breakers 7SQ1 and 7SQ2 and make certain that the following circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION CAPT EFIS ND	37FN1	104/F1
21VU	NAVIGATION CAPT EFIS CTL PNL	43FN1	104/F3
21VU	NAVIGATION CAPT EFIS SGU 1	30FN1	104/F4
21VU	NAVIGATION EFIS SGU 3	30FN3	104/F6
21VU	NAVIGATION F/O EFIS SGU 2	30FN2	104/F11
21VU	NAVIGATION F/O EFIS CTL PNL	43FN2	104/F12
21VU	NAVIGATION F/O EFIS ND	37FN2	104/F14
22VU	NAVIGATION CAPT INST SWITCHING	SFN1	204/F16
21VU	NAVIGATION F/O INST SWITCHING	SFN2	104/F8
281VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS1/BAT	313FP1	A08
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS1/115VAC	312FP1	208/B22
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS3/115VAC	312FP3	208/B23
281VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS3/BAT	313FP3	A07

(7)Switch on the EFIS (Ref. 34-71-00, P. Block 1).
(8)On Overhead Panel make certain that the mode selector switch MSU 3 is in OFF position.

D. Test
(1)Test of Weather Radar interface with IRS and SGU 3.

R **ON A/C 101-200,

R 2. System Test

A. Reason for the Job
(1)Test of Weather Radar interface with IRS and SGU3.
(2)Check of antenna control function.
(3)Test of Weather Radar transceiver.

B. Equipment and Materials
Referenced Procedures
- 21-20-00, P. Block 301 Air Conditioning - Distribution/Extraction
- 24-41-00, P. Block 301 AC External Power Control
- 34-41-00, P. Block 1 Weather Radar
- 34-71-00, P. Block 501 EFIS

C. Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT CIRCUITS UPON WHICH WORK IS TO BE PERFORMED ARE ISOLATED.

WARNING : DUE TO THE RISK OF INJURY TO PERSONNEL OR DAMAGE TO THE EQUIPMENT WHEN THE TRANSCEIVER IS TRANSMITTING, THE FOLLOWING PRECAUTIONS MUST BE OBSERVED:
- NO-ONE MAY STAND IN FRONT OF THE ANTENNA AT A DISTANCE OF LESS THAN 5 METERS WITHIN AN ARC OF ± 135° OF THE AIRCRAFT CENTERLINE. (THE DANGER IS EVEN GREATER WHEN THE ANTENNA IS NOT SCANNING).
- DO NOT LOOK INTO THE WAVEGUIDE WHEN THE TRANSCEIVER IS OPERATING.
- NO RE-FUELING OPERATIONS MUST BE CARRIED OUT WITHIN THE VICINITY OF THE AIRCRAFT.
- MAINTAIN A MINIMUM SAFETY DISTANCE OF 5 METERS BETWEEN THE AIRCRAFT AND ANY METALLIC OBJECT WITHIN AN ARC OF ± 90° OF THE AIRCRAFT CENTERLINE.

WARNING : THE HIGH VOLTAGES AND FREQUENCIES REQUIRED FOR WEATHER RADAR OPERATION FORBID ANY INTERFERENCE WITH THIS EQUIPMENT WHEN IT IS ENERGIZED.

R (1) Connect the electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
R (2) Make certain that the forward services ventilation is operating (Ref. 21-20-00, P. Block 301).
(3) On weather radar control panel 3SQ make certain that:
R - the SYS 1/OFF/2 switch is set to OFF.
R - the TILT selector switch is set to 0 position.
(4) Open, safety and tag the following circuit breaker:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADAR TR 1	7SQ1	107/C6

(5) Open the radome.

NOTE : Two persons are required to open the radome.

CAUTION : ENSURE THAT THE RADOME SUPPORT STAYS ARE CORRECTLY LOCKED.

(6) Close circuit breaker 7SQ1 and make certain that the following circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION CAPT EFIS ND	37FN1	104/F1
21VU	NAVIGATION CAPT EFIS CTL PNL	43FN1	104/F3
21VU	NAVIGATION CAPT EFIS SGU 1	30FN1	104/F4

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION EFIS SGU 3	30FN3	104/F6
21VU	NAVIGATION F/O EFIS SGU 2	30FN2	104/F11
21VU	NAVIGATION F/O EFIS CTL PNL	43FN2	104/F12
21VU	NAVIGATION F/O EFIS ND	37FN2	104/F14
22VU	NAVIGATION CAPT INST SWITCHING	SFN1	204/F16
21VU	NAVIGATION F/O INST SWITCHING	SFN2	104/F8
281VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS1/BAT	313FP1	A08
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS1/115VAC	312FP1	208/B22
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS3/115VAC	312FP3	208/B23
281VU	MIN EQPT BAY SUPPLY/NAVIGATION/IRS3/BAT	313FP3	A07

(7)Switch on the EFIS (Ref. 34-71-00, P. Block 1).
(8)On Overhead Panel make certain that mode selector switch MSU 3 is in OFF position.

D. Test
(1)Test of Weather Radar interface with IRS and SGU 3.

R **ON A/C 001-100,

NOTE : The subsequent test procedure refers to WR1; to do the same test for WR2 refer to the references between the parentheses.

ACTION	RESULT
1. On the overhead panel: - Put the MSU1 (MSU2) mode selector switch to the NAV or ATT position.	The attitude signal is available after approximately 10 seconds.
2. On the CAPT and the F/O EFIS control panel 8VU: - Put the mode selector switch to ARC or to MAP.	On the two Navigation Displays (ND): - The ARC or MAP images are shown.
3. On the weather radar control panel 11VU: - Turn the rotary TEST/WX/TURB/MAP switch to the WX position. - Put the SYS 1/OFF/2 switch to 1 (2).	- The radar images are shown.
4. On the overhead panel: - Put the MSU1 (MSU2) mode selector switch to the OFF position. - Put the MSU3 mode selector switch to the NAV or ATT position.	- The amber WR ATT messages come on. - After approximately 10 seconds, the amber WR ATT messages go off.
5. On the circuit breaker panel 21VU: - Open the circuit breakers CAPT EFIS SGU 1 (30FN1,F4) and	- The shown radar images go off. - The diagonal lines come on.

ACTION	RESULT
F/O EFIS SGU 2 (30FN2, F11).	
6. On the F/O switching panel (6VU or 406VU)): - Press to arrest the EFIS SGU push-button switch.	On the CAPT ND: - The diagonal line remains on. On the F/O ND: - The diagonal line goes off. - The radar image is shown.
7. On the CAPT switching panel (2VU or 402VU): - Press to arrest the EFIS SGU push-button switch.	On the CAPT ND: - The diagonal line goes off. - The radar image is shown. On the F/O ND: - the shown radar image goes off. - A diagonal line comes on.
8. On the F/O switching panel (6VU or 406VU)): - Press to release the EFIS SGU push-button switch.	On the two ND: - No change is observed.
9. On the CAPT switching panel (2VU or 402VU): - Press to release the EFIS SGU push-button switch.	On the CAPT ND: - The shown radar image goes off. - A diagonal line comes on. On the F/O ND: - The diagonal line remains on.
10. On the circuit breaker panel 21VU: - Close the circuit breakers CAPT EFIS SGU 1 (30FN1, F4) and F/O EFIS SGU 2 (30FN2, F11).	On the two ND: - The diagonal lines go off. - The radar images are shown.
11. On the overhead panel: - Put the MSU3 mode selector switch to the OFF position.	- The amber WR ATT messages come on.
12. On the weather radar control panel 11VU: - Put the SYS 1/OFF/2 switch to OFF.	- The radar images go off.
13. Do again steps 1. thru 12. to test the WR2 system.	

ACTION	RESULT
**ON A/C 101-200,	
NOTE : The subsequent test procedure refers to WR1; to do the same test for WR2 refer to the references between the parentheses.	
ACTION	**RESULT**
1. On the overhead panel: - Put the MSU1 (MSU2) mode selector switch to the NAV or ATT position.	The attitude signal is available after approximately 10 seconds.
2. On the CAPT and the F/O EFIS control panel 8VU: - Put the mode selector switch to ARC or to MAP.	On the two Navigation Displays (ND): - The ARC or MAP images are shown.
3. On the weather radar control panel 11VU: - Put the SYS1/OFF/SYS2 switch to SYS1 (SYS2).	- The radar images are shown.
4. On the overhead panel: - Put the MSU1 (MSU2) mode selector switch to the OFF position. - Put the MSU3 mode selector switch to the NAV or ATT position.	- The amber WR ATT messages come on. - After approximately 10 seconds, the amber WR ATT messages go off.
5. On the circuit breaker panel 21VU: - Open the circuit breakers CAPT EFIS SGU 1 (30FN1,F4) and F/O EFIS SGU 2 (30FN2, F11).	- The shown radar images go off. - The diagonal lines come on.
6. On the F/O switching panel (6VU or 406VU)): - Press to arrest the EFIS SGU push-button switch.	On the CAPT ND: - The diagonal line remains on. On the F/O ND: - The diagonal line goes off. - The radar image is shown.
7. On the CAPT switching panel (2VU or 402VU): - Press to arrest the EFIS SGU push-button switch.	On the CAPT ND: - The diagonal line goes off. - The radar image is shown. On the F/O ND: - the shown radar image goes off. - A diagonal line comes on.

ACTION	RESULT
8. On the F/O switching panel (6VU or 406VU)): - Press to release the EFIS SGU push-button switch.	On the two ND: - No change is observed.
9. On the CAPT switching panel (2VU or 402VU): - Press to release the EFIS SGU push-button switch.	On the CAPT ND: - The shown radar image goes off. - A diagonal line comes on. On the F/O ND: - The diagonal line remains on.
10. On the circuit breaker panel 21VU: - Close the circuit breakers CAPT EFIS SGU 1 (30FN1, F4) and F/O EFIS SGU 2 (30FN2, F11).	On the two ND: - The diagonal lines go off. - The radar images are shown.
11. On the overhead panel: - Put the MSU3 mode selector switch to the OFF position.	- The amber WR ATT messages come on.
12. On the weather radar control panel 11VU: - Put the SYS1/OFF/SYS2 switch to OFF.	- The radar images go off.
13. Do again steps 1. thru 12. to test the WR2 system.	

**ON A/C 001-100,

(2) Check of antenna control function.
Carry out an operational test (para. 1) and observe, from the rear, that the flat plate antenna:
(a) performs an azimuth scan from left to right over the range ± 90°; then
(b) performs an elevation scan from up to down over the range ± 15°; and
(c) comes to rest at the aircraft centerline.

(3) Test of weather radar transceiver
In electronics bay, panel 115VU, at transceiver 1, press and hold the TEST pushbutton switch on the front panel. Verify that all of the LEDs come on momentarily and then go off.
NOTE : Any LEDs that remain on are indicative of a detected and stored failure (Ref. 34-41-00, P. Block 1, para. 5.A.(2)).
Repeat the test for transceiver 2, if installed.

E. Close-Up
(1) On Weather Radar Control Panel 3SQ, switch off the radar.

(2)Switch off the EFIS (Ref. 34-71-00, P. Block 1).
(3)Switch off Forward Services Ventilation (Ref. 21-21-00, P. Block 1).
(4)De-energize the aircraft electrical network and disconnect electrical ground power unit (Ref. 24-41-00, P. Block 301).
(5)Remove support struts and close radome.
NOTE : Two persons are required to close radome.

**ON A/C 101-200,

(2)Check of antenna control function.
Carry out an operational test (para. 1) and observe, from the rear, that the flat plate antenna:
(a)performs an azimuth scan from left to right over the range ± 90°; then
(b)performs an elevation scan from up to down over the range ± 15°; and
(c)comes to rest at the aircraft centerline.
(3)Test of weather radar transceiver
In electronics bay, panel 115VU, at transceiver 1, press and hold the TEST pushbutton switch on the front panel. Verify that all of the LEDs come on momentarily and then go off.

NOTE : Any LEDs that remain on are indicative of a detected and stored failure (Ref. 34-41-00, P. Block 1, para. 5.A.(2)).

E. Close-Up
(1)On Weather Radar Control Panel 11VU, set the SYS1/OFF/SYS2 switch to OFF.

(2)Switch off the EFIS (Ref. 34-71-00, P. Block 1).
(3)Switch off Forward Services Ventilation (Ref. 21-21-00, P. Block 1).
(4)De-energize the aircraft electrical network and disconnect electrical ground power unit (Ref. 24-41-00, P. Block 301).
(5)Remove support struts and close radome.
NOTE : Two persons are required to close radome.

R **ON A/C ALL

3. Functional Test of the Tilt Control of the Weather Radar Antenna Dual Drive

WARNING : MAKE CERTAIN THAT :
-ALL PERSONS ARE MORE THAN 5 METERS (16.4FT) FROM THE ANTENNA.
-NO PERSON IS IN THE AREA MADE BY AN ARC OF 135° ON EACH SIDE OF THE AIRCRAFT CENTERLINE.
-THERE IS A MINIMUM SAFETY DISTANCE OF 5 METERS (16.4FT) BETWEEN THE AIRCRAFT AND ANY OBSTACLE IN THE AREA MADE BY AN ARC OF 90° ON EACH SIDE OF THE AIRCRAFT CENTERLINE.
THE AIRCRAFT MUST NOT BE IN A HANGAR OR CLOSED AREA.

A. Reason for the Job
(1)Self explanatory

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Access Platform, 4.6 to 7 m (15 to 23 ft.)
(2)98F34403500000	DUMMY LOAD
Referenced Procedures	
- 21-20-00, P. Block 1	Air Conditioning - Distribution
- 24-41-00, P. Block 301	AC External Power Control
- 34-41-25, P. Block 401	Waveguide Assembly
- 34-71-00, P. Block 501	EFIS General
- 53-10-61, P. Block 201	Opening of Radome 110AL

C. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADAR TR 1	7SQ1	107/C6
21VU	RADAR TR 2	7SQ2	107/C9

WARNING : DO NOT OPEN THE RADOME IF THE WIND SPEED IS MORE THAN 35 KNOTS.

NOTE : Two persons are necessary to open the radome.

(2)Put access platform in position below radome.

(3)Open access door 121BL and radome 110AL (Ref. 53-10-61, P. Block 201).

CAUTION : ENSURE THAT THE RADOME SUPPORT STAYS ARE CORRECTLY LOCKED.

(4)Release quick-disconnect fastener to disconnect waveguide assembly from antenna dual drive (Ref. 34-41-25, P. Block 401).

(5)Remove O-ring.

(6)Install DUMMY LOAD (98F34403500000) (cone in down direction) on waveguide assembly.

(7)Do not install O-ring between waveguide assembly and dummy load.

(8)Make certain that there is no space between waveguide assembly and dummy load and that their connection is correct.

(9)Remove the two screws that prevent operation of AZ and EL selector switches on antenna dual drive.

(10)Make certain that AZ and EL selector switches are at ON and that antenna is free to move in azimuth and in elevation.

(11)Connect electrical ground power unit and energize aircraft electrical network (Ref. 24-41-00, P. Block 301).

(12)Make certain that forward services ventilation is operating (Ref. 21-20-00, P. Block 1).

(13)Remove safety clips and tags and close circuit breakers 7SQ1 and 7SQ2.

(14)Make certain that the following circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION CAPT EFIS ND	37FN1	104/F1
21VU	NAVIGATION CAPT EFIS PFD	35FN1	104/F2
21VU	NAVIGATION CAPT EFIS CTL PNL	43FN1	104/F3
21VU	NAVIGATION CAPT EFIS SGU 1	30FN1	104/F4
21VU	NAVIGATION CAPT EFIS RMI ADF	46FN1	104/F5
21VU	NAVIGATION EFIS SGU 3	30FN3	104/F6
21VU	NAVIGATION F/O INST SW	5FN2	104/F8
21VU	NAVIGATION F/O EFIS RMI ADF	46FN2	104/F9
21VU	NAVIGATION F/O RMI VOR/DME	11FN2	104/F10
21VU	NAVIGATION F/O EFIS SGU 2	30FN2	104/F11
21VU	NAVIGATION F/O EFIS CTL PNL	43FN2	104/F12
21VU	NAVIGATION F/O EFIS PFD	35FN2	104/F13
21VU	NAVIGATION F/O EFIS ND	37FN2	104/F14
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/ IRS3/115VAC	313FP1	208/B21
22VU	MIN EQPT BAY SUPPLY/NAVIGATION/ IRS1/115VAC	312FP1	208/B22

R **ON A/C 001-100,

(15)On center pedestal 11VU, on weather radar control box (3SQ), make certain that :
- SYS1/OFF/SYS2 or PWR switch is set to OFF
- TILT selector switch is in the 0 position
- GAIN potentiometer is set to CAL or in the 0 position (if applicable)
- Weather radar mode selector switch is set to WX (if applicable).

(16)Switch on EFIS (Ref. 34-71-00, P. Block 501).

D. Test

R **ON A/C 101-200,

(15)On center pedestal 11VU, on weather radar control box (3SQ), make certain that :
- SYS1/OFF/SYS2 switch is set to OFF
- TILT selector switch is in the 0 position
- GAIN potentiometer is set to AUTO (if applicable)
- Weather radar mode selector switch is set to WX (if applicable).

(16)Switch on EFIS (Ref. 34-71-00, P. Block 501).

D. Test

R **ON A/C ALL

NOTE : Two persons are necessary to do the test :
- one person must be in flight compartment to set the switches on weather radar control box
- another person must be near the weather radar antenna

to do the check of the tilt value on the indicator of antenna dual drive.

ACTION	RESULT
1. On center pedestal 11VU, on weather radar control box (3SQ) : - Set system switch to 1 (or ON).	Antenna turns in azimuth.
2. On antenna dual drive : - Set EL and AZ selector switches to OFF	Antenna scanning stops after some seconds. On CAPT and F/O NDs : - Red WXR ANT indication comes into view.
3. Turn antenna manually and carefully along aircraft centerline.	
4. On antenna dual drive : - Set EL selector switch to ON (AZ selector switch stays at OFF).	
5. On center pedestal 11VU, on weather radar control box (3SQ) : - Gradually turn TILT selector switch to 5 deg.up (5 UP notch)	On elevation indicator of antenna dual drive : - Antenna turns in elevation 5 deg. up.
6. Gradually turn TILT selector switch to 10 deg. up (10 UP notch)	- Antenna turns in elevation 10 deg. up.
7. Gradually turn TILT selector switch to 15 deg. up (15 UP notch)	- Antenna turns in elevation 15 deg. up.
8. Gradually turn TILT selector switch to 5 deg. down (5 DN notch)	- Antenna turns in elevation 5 deg. down.
9. Gradually turn TILT selector switch to 10 deg. down (10 DN notch)	- Antenna turns in elevation 10 deg. down.
10. Gradually turn TILT	- Antenna turns in elevation

ACTION	RESULT
selector switch to 15 deg. down (15 DN notch)	15 deg. down.
11.Gradually turn TILT selector switch to 0 deg.	- Antenna turns in elevation 0 deg.
12.Turn manually and carefully antenna to 90 deg. right and do again steps 7 through 13.	
13.Turn manually and carefully antenna to 90 deg. left and do again steps 7 through 13.	
14.On radome, turn manually and carefully antenna along aircraft centerline (0 deg. in azimuth and in elevation).	
15.On center pedestal 11VU, on weather radar control box (3SQ) : - set system switch to OFF.	
16.On antenna dual drive : - Set AZ selector switch to ON.	

R **ON A/C 001-100,

E. Close-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADAR TR 1	7SQ1	107/C6
21VU	RADAR TR 2	7SQ2	107/C9

(2)Remove dummy load from waveguide assembly.

(3)Install O-ring on waveguide connector on antenna dual drive.

(4)Connect waveguide assembly to antenna dual drive and lock quick-disconnect fastener (Ref. 34-41-25, P. Block 401).

(5)Make certain that AZ and EL selector switches are at ON and that antenna is free to move in azimuth and in elevation.

(6)Install and tighten the two screws that prevent operation of AZ and EL selector switches on antenna dual drive.

(7)On center pedestal 11VU, on weather radar control box (3SQ), make

certain that :
- SYS1/OFF/SYS2 or PWR switch is set to OFF.

(8)Switch off EFIS (Ref. 34-71-00, P. Block 501).
(9)Remove safety clips and tags and close circuit breakers 7SQ1 and 7SQ2.
(10)De-energize aircraft electrical network (Ref. 24-41-00, P. Block 301).
(11)Make certain that work area is clean and clear of tools and other items.
(12)Close access door 121BL and radome 110AL (Ref. 53-10-61, P. Block 201).
(13)Remove access platform.

R **ON A/C 101-200,

E. Close-Up
(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADAR TR 1	7SQ1	107/C6
21VU	RADAR TR 2	7SQ2	107/C9

(2)Remove dummy load from waveguide assembly.
(3)Install O-ring on waveguide connector on antenna dual drive.
(4)Connect waveguide assembly to antenna dual drive and lock quick-disconnect fastener (Ref. 34-41-25, P. Block 401).
(5)Make certain that AZ and EL selector switches are at ON and that antenna is free to move in azimuth and in elevation.
(6)Install and tighten the two screws that prevent operation of AZ and EL selector switches on antenna dual drive.
(7)On center pedestal 11VU, on weather radar control box (3SQ), make certain that :
- SYS1/OFF/SYS2 switch is set to OFF.

(8)Switch off EFIS (Ref. 34-71-00, P. Block 501).
(9)Remove safety clips and tags and close circuit breakers 7SQ1 and 7SQ2.
(10)De-energize aircraft electrical network (Ref. 24-41-00, P. Block 301).
(11)Make certain that work area is clean and clear of tools and other items.
(12)Close access door 121BL and radome 110AL (Ref. 53-10-61, P. Block 201).
(13)Remove access platform.

R CAUTION : THE ANTENNA ASSEMBLY (ANTENNA AND DUAL DRIVE) WEIGHS APPROXIMA-
R TELY 15.5 Kg. (34 LB) AND REQUIRES AN ACCESS PLATFORM FOR 2 PEOPLE
R FOR REMOVAL. HANDLE CAREFULLY TO PREVENT INJURY TO PERSONNEL OR
R DAMAGE TO THE ANTENNA ASSEMBLY.

R 1. Reason for the Job

R A. Removal and installation of antenna (planar array)

R B. Removal and installation of antenna assembly

R 2. Antenna (planar array)
R (Ref. Fig. 401)

R A. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 4.50 m (14 ft. 9 in.)
B.	Blanking Plugs/Caps
C.	Circuit Breaker Safety Clips
Referenced Procedure	
- 34-41-00, P. Block 501	Weather Radar System
- 53-10-61, P. Block 201	Opening/Closing of the Radome

R B. Procedure
R (1)Job Set-Up
R (a)Open, safety and tag the following circuit breakers :

**ON A/C 001-003, 102-200,

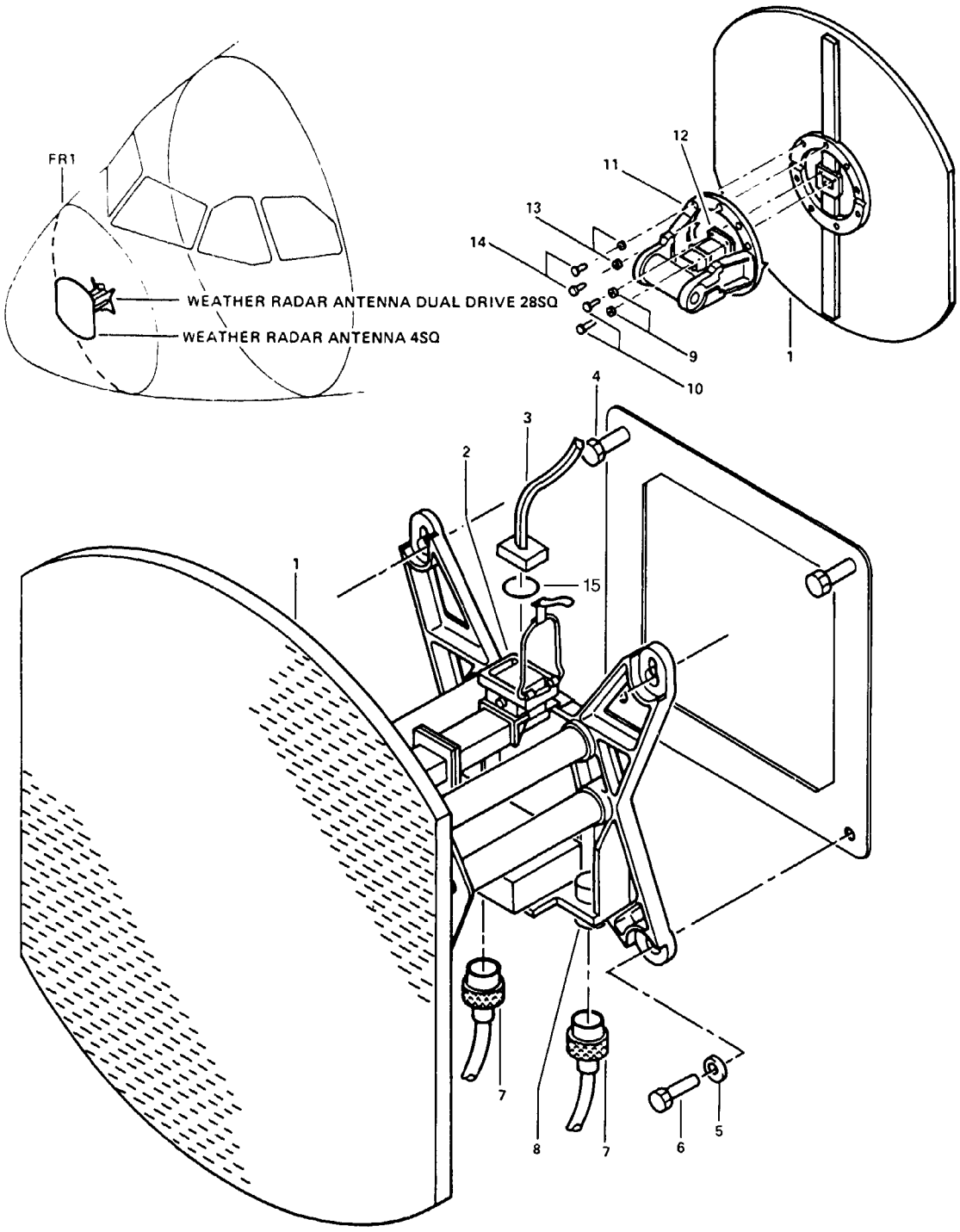
PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/RADAR/TR1	7SQ1	107/C 6

**ON A/C 004-101,

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/RADAR/TR1	7SQ1	107/C 6
21VU	RADIO-NAV & COM/RADAR/TR2	7SQ2	107/C 7

**ON A/C ALL

R (b)Position access platform beneath radome.
R (c)Open radome and make certain that support struts are correctly locked
(Ref. 53-10-61, P. Block 201).
(2)Removal of antenna (planar array)



BM5 34 41 11 4 AAM2 01

Weather Radar Antenna Assembly
Figure 401

R

CAUTION : DO NOT USE THE LOCALIZER ANTENNA AT THE BOTTOM OF THE RADOME BULKHEAD AS A FOOT STEP OR SUPPORT.

(a)Remove four socket head cap screws (10) and lockwashers (9) attaching flexible waveguide flange (12) and planar array (1) waveguide flange.
(b)Retain screws and lockwashers.
(c)Remove eight socket head cap screws (14) and lockwashers (13) attaching ring mount (11) and planar array (1). Retain screws and lockwashers.

(3)Installation of antenna (planar array)
(a)Install planar array (1) onto ring mount (11) and secure using eight socket head cap screws (14) and lockwashers (13) removed in step B.(2)(c).
(b)Mate drive unit flexible waveguide flange (12) to planar array (1) waveguide flange and secure using four head cap screws (10) and lockwashers (9) removed in step B.(2)(a).

**ON A/C 001-100,

(c)Remove safety clips and tags and close circuit breakers 7SQ1 and 7SQ2.

**ON A/C 101-200,

(c)Remove safety clip and tag and close circuit breaker 7SQ1.

**ON A/C ALL

(4)Test
Carry out system test of weather radar (Ref. 34-41-00, P. Block 501, para. check of antenna control function).

(5)Close-Up
(a)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(b)Close radome and check that latches are correctly latched.
(c)Remove access platform.

R 3. Antenna Assembly
R (Ref. Fig. 401)

R A. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 4.50 m (14 ft. 9 in.)
B.	Blanking Plugs/Caps
C.	Circuit Breaker Safety Clips
D. 44834	O-Ring
Referenced Procedure	
- 34-41-00, P. Block 501	Weather Radar System
- 53-10-61, P. Block 201	Opening/Closing of the Radome

R B. Procedure

R (1)Job Set-Up
R (a)Open, safety and tag the following circuit breakers :

R **ON A/C 001-003, 102-200,

R PANEL	SERVICE	IDENT.	LOCATION
R 21VU	RADIO-NAV & COM/RADAR/TR1	7SQ1	107/C 6

R **ON A/C 004-101,

R 21VU	RADIO-NAV & COM/RADAR/TR1	7SQ1	107/C 6
R 21VU	RADIO-NAV & COM/RADAR/TR2	7SQ2	107/C 7

R **ON A/C ALL

R (b)Position access platform beneath radome.
R (c)Open radome and make certain that support struts are correctly locked
R (Ref. 53-10-61, P. Block 201).
R (2)Removal of antenna assembly
R (a)Disconnect electrical connectors (7).
R (b)Remove aircraft waveguide (3) from antenna assembly by means of quick-
R disconnect fitting (2).
R (c)Remove and discard O-ring (15).
R (d)Cap electrical connectors (7) and (8) and waveguide (3).
R (e)Remove the two lower screws (6) and washers (5).
R (f)Loosen the two upper screws (4), do not remove.
R (g)Lift antenna assembly up until the holes come up to screw heads (4),
R pull gently and remove antenna assembly.
R (h)Put antenna in a plastic bag and place in a suitable container.
R (3)Installation of antenna assembly
R (a)Remove blanking caps from electrical connectors (7) and (8) and from
R aircraft waveguide (3).
R (b)Make certain that the two upper screws (4) are loose enough.
R (c)Lift antenna assembly up to its support.
R (d)Position antenna assembly which is then retained by the two upper
R screws (4).
R (e)Install the two lower screws (6) and washers (5).
R (f)Tighten the four screws (4) and (6).
R (g)Put O-ring (15) in the correct position on flange of waveguide (3).
R (h)Connect waveguide (3) to antenna assembly by means of quick-disconnect
R fitting (2).

R CAUTION : MAKE CERTAIN THAT SEAL IS IN POSITION BETWEEN WAVEGUIDE AND
R ANTENNA ASSEMBLY.

R (j)Connect electrical connectors (7) to antenna assembly.
R (k)Manually check correct rotation of the antenna assembly in elevation
R (EL) and azimuth (AZ). Visually check correct position of AZ and EL

R switches and that pins prohibiting actuation of switches are installed.

R **ON A/C 001-100,

R (l)Remove safety clips and tags and close circuit breakers 7SQ1 and 7SQ2.

R **ON A/C 101-200,

R (l)Remove safety clip and tag and close circuit breaker 7SQ1.

R **ON A/C ALL

(4)Test
Carry out system test of weather radar (Ref. 34-41-00, P. Block 501, para. check of antenna control function).
(5)Close-Up
(a)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(b)Close radome and check that latches are correctly latched.
(c)Remove access platform.

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-41-00, P. Block 501	Weather Radar System

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :

**ON A/C 001-003, 102-200,

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM-RADAR TR1	7SQ1	107/C 6

**ON A/C 004-101,

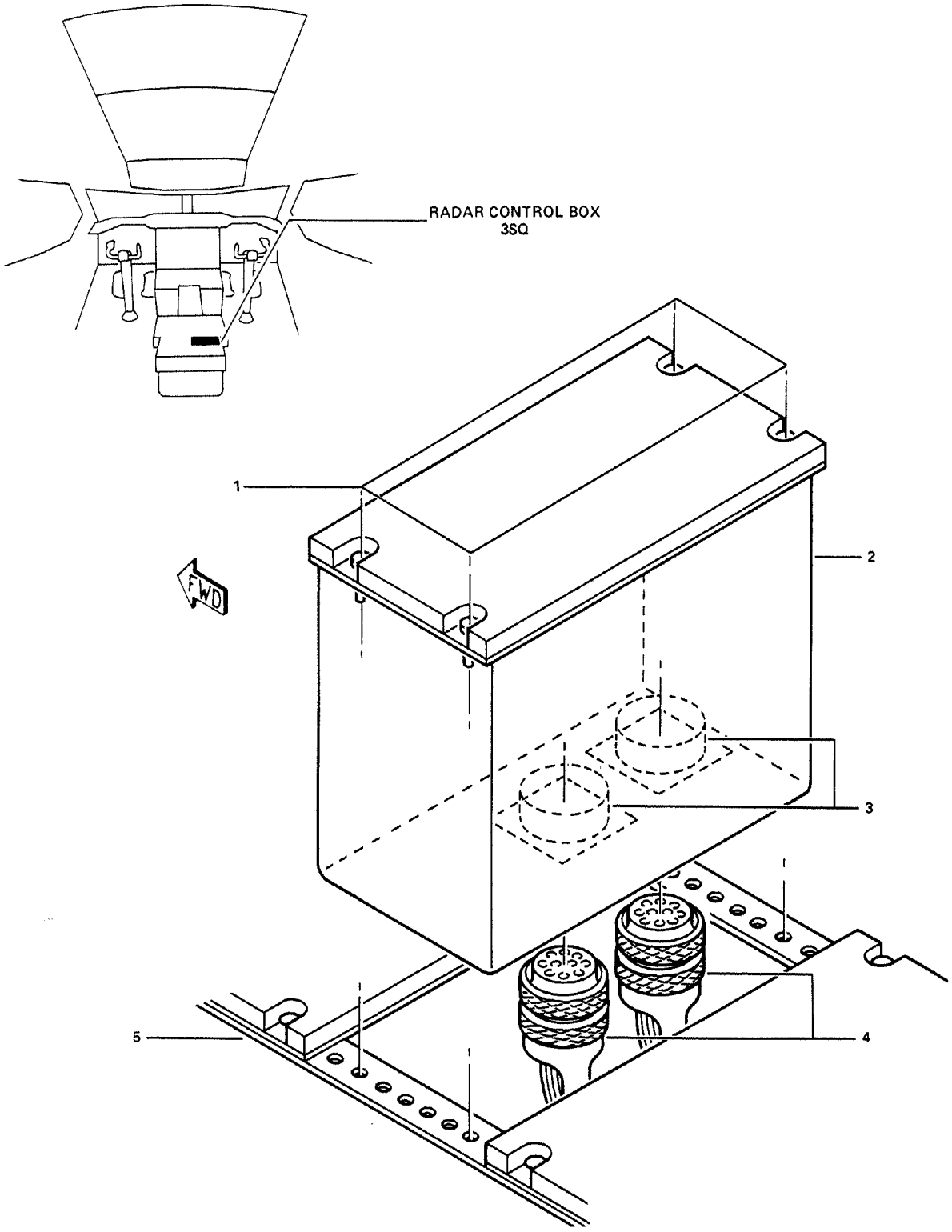
21VU	RADIO-NAV & COM-RADAR TR1	7SQ1	107/C 6
21VU	RADIO-NAV & COM-RADAR TR2	7SQ2	107/C 7

**ON A/C ALL

132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77

B. Removal
(1)Unlock the four Dzus fasteners (1).
(2)Pull radar control box (2) forward.
(3)Disconnect electrical connectors (4) and hold them outside panel (5).
(4)Blank electrical connectors (3) and (4).
(5)Remove radar control box.

C. Installation
(1)Clean and inspect radar control box interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (3) and (4) and visually check condition of pins.
(3)Position radar control box (2).
(4)Connect electrical connectors (4) to their corresponding receptacles (3) on control box.
(5)Install radar control box (2) on structure (5).
(6)Lock the four Dzus fasteners (1).



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Radar Control Box
Figure 401

R **ON A/C 101-200,

(7)Remove safety clips and tags and close circuit breakers 7SQ1, and 3LF.

R **ON A/C 001-100,

(7)Remove safety clips and tags and close circuit breakers 7SQ1, 7SQ2 and 3LF.

R **ON A/C ALL

D. Test
Carry out operational test of weather radar system (Ref. 34-41-00, P. Block 501).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

WAVEGUIDE ASSEMBLY (11SQ, 14SQ) - REMOVAL/INSTALLATION

1. Equipement and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
C. 44834	O-Ring
D. 1005153-1	Waveguide Cover (SPERRY)
Referenced Procedure - 34-41-00, P. Block 501	Weather Radar System

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :

R **ON A/C 001-003, 102-200,

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/RADAR TR1	7SQ1	107/C6

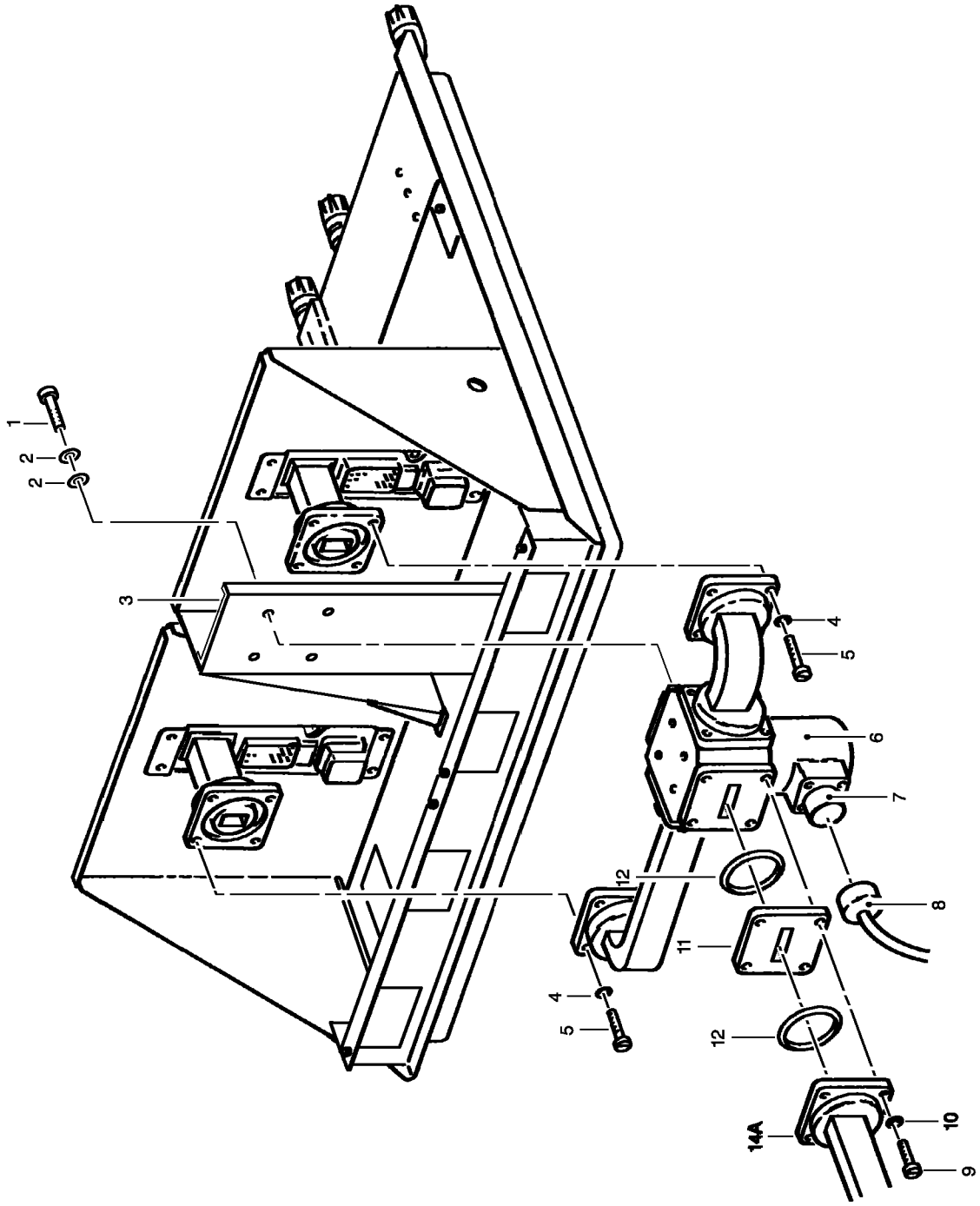
R **ON A/C 004-101,

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/RADAR TR1	7SQ1	107/C6
21VU	RADIO-NAV & COM/RADAR TR2	7SQ2	107/C7

**ON A/C ALL

(2)Open access door 121BL to gain access to avionics compartment.

B. Removal of Waveguide Switch
(Ref. Fig. 401)
(1)Disconnect electrical connector (8) from waveguide switch (6).
(2)Cap electrical connectors (8) and (7).
(3)Remove the four screws (9) and four washers (10) from aircraft waveguide end (14A).
(4)Remove and discard O-rings (12) and pressurization window (11) if necessary.
(5)Cap aircraft waveguide end (14A) and waveguide switch (6).
(6)Remove the eight screws (5) and eight washers (4).
(7)Holding waveguide switch (6), remove the four screws (1) and eight washers (2).



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Waveguide Switch
Figure 401

(8)Disengage waveguide switch (6) from support (3).

C. Removal of Waveguide Assembly Parts in Avionics Compartment
(Ref. Fig. 402)

(1)Part 14 :

(a)Remove the two lockwires, the four screws (9) and four washers (10) from aircraft waveguide end (14A).

R (b)Remove the pressurization window (11).

(c)Remove and discard O-rings (12) if necessary.

(d)Cap aircraft waveguide end (14A) and waveguide switch (6).

(e)Remove the two lockwires, the four screws (15) and four washers (16) from aircraft waveguide ends (14B) and (19A).

(f)Remove and discard O-ring (17) if necessary.

(g)Cap aircraft waveguide end (19A).

(2)Part 19 :

(a)Remove the screw (20) and washer (18) from the clamp (21) and remove the bushing (22).

(b)Remove the two lockwires, the four screws (15) and four washers (16) from aircraft waveguide ends (14B) and (19A).

(c)Remove and discard O-ring (17) if necessary.

(d)Cap aircraft waveguide end (14B).

(e)Remove the two lockwires, the four screws (23) and four washers (26) from aircraft waveguide ends (19B) and (27A).

(f)Remove and discard O-ring (25) if necessary.

(g)Cap aircraft waveguide end (27A).

(3)Part 27

(a)Remove the two lockwires, the four screws (23) and four washers (26) from aircraft waveguide ends (19B) and (27A).

(b)Remove and discard O-ring (25) if necessary.

(c)Cap aircraft waveguide end (19B).

(d)Remove the two lockwires, the four screws (28) and four washers (30) from aircraft waveguide end (27B) and pressure seal (31).

(e)Remove and discard O-ring (29) if necessary.

(f)Cap pressure seal (31).

D. Removal of Waveguide Assembly Parts in Radome
(Ref. Fig. 403)

(1)Part 34 :

(a)Unlatch the snap fasteners which retain aircraft waveguide end (34A) and antenna waveguide window.

(b)Remove and discard O-ring (37) if necessary.

(c)Cap antenna waveguide window.

(d)Remove the two lockwires, the four screws (40) and four washers (41) from aircraft waveguide ends (34B) and (42A).

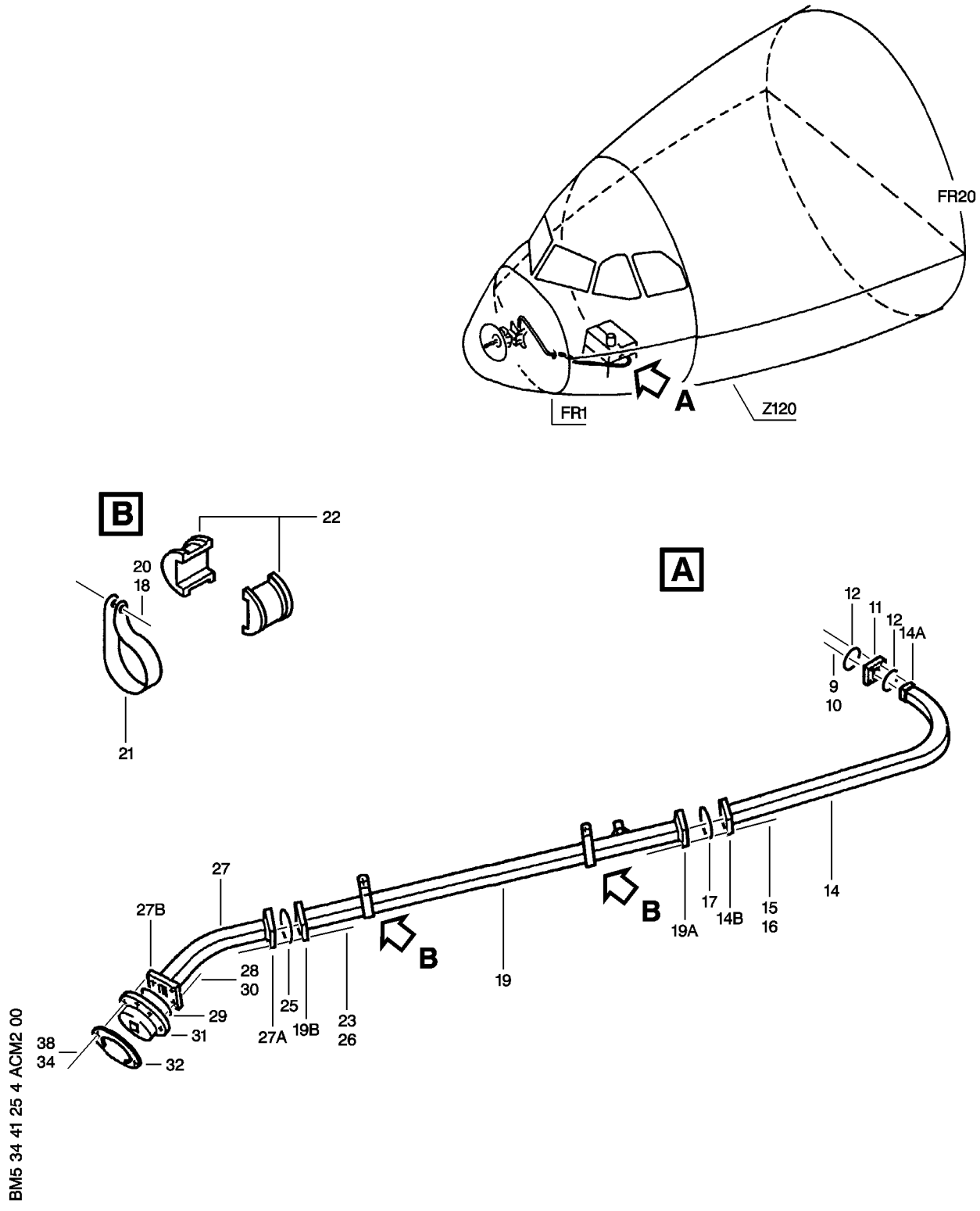
(e)Remove and discard O-ring (39) if necessary.

(f)Cap aircraft waveguide end (42A).

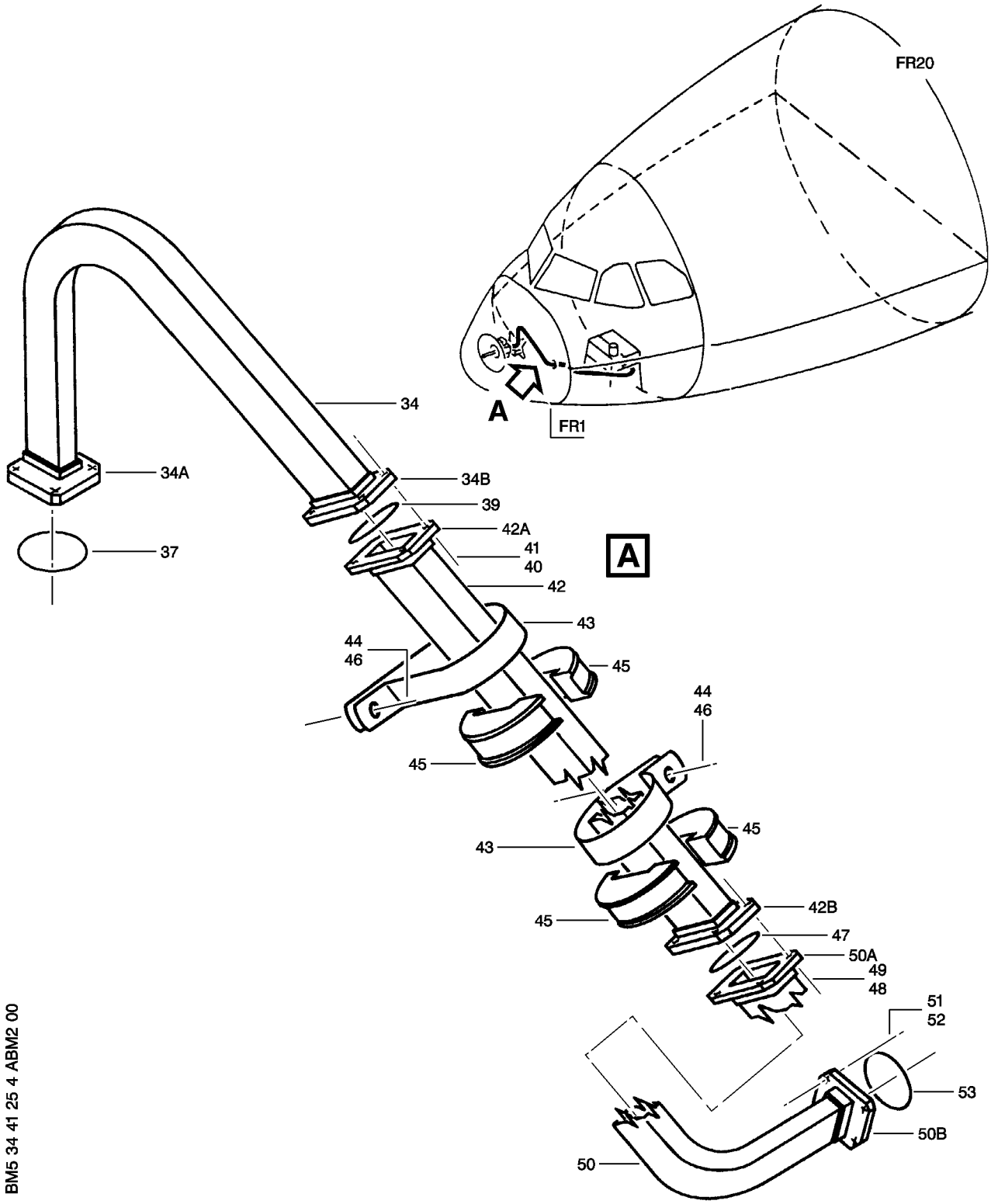
(2)Part 42 :

(a)Remove the screw (44) and washer (46) from the two clamps (43) and remove the bushings (45).

(b)Remove the two lockwires, the four screws (40) and four washers (41) from aircraft waveguide ends (34B) and (42A).



Waveguide Assembly in Avionics Compartment
Figure 402



Waveguide Assembly in Radome
Figure 403

R

(c)Remove and discard O-ring (39) if necessary.
(d)Cap aircraft waveguide end (34B).
(e)Remove the two lockwires, the four screws (48) and four washers (49) from aircraft waveguide ends (42B) and (50A).
(f)Remove and discard O-ring (47) if necessary.
(g)Cap aircraft waveguide end (50A).

(3)Part 50 :
(a)Remove the two lockwires, the four screws (48) and four washers (49) from aircraft waveguide ends (42B) and (50A).
(b)Remove and discard O-ring (47) if necessary.
(c)Cap aircraft waveguide end (42B).
(d)Remove the two lockwires, the four screws (51) and four washers (52) from aircraft waveguide end (50B) and pressure seal.
(e)Remove and discard O-ring (53) if necessary.
(f)Cap pressure seal.

E. Preparation of Replacement Component
Make certain that O-rings (12) and pressurization window (11) are in correct condition.

F. Installation of Waveguide Switch
(Ref. Fig. 401)
(1)Clean and inspect waveguide switch (6) interface and adjacent area.
(2)Position waveguide switch (6) on support (3).
(3)Install the four screws (1) and eight washers (2). Do not tighten.
(4)Install the eight screws (5) and eight washers (4).
(5)Tighten the four screws (1).
(6)Remove caps from aircraft waveguide end (14A) and waveguide switch (6).
(7)Position one O-ring (12), the pressurization window (11) and the other O-ring (12) between aircraft waveguide end (14A) and waveguide switch (6).
(8)Install the four screws (9) and four washers (10).
(9)Remove caps from electrical connectors (7) and (8) and check for correct condition of connectors.
(10)Connect electrical connector (8) to connector (7) on waveguide switch (6).

R **ON A/C 101-200,

R (11)Remove safety clip and tag and close circuit breaker 7SQ1.

R **ON A/C 001-100,

(11)Remove safety clips and tags and close circuit breakers 7SQ1 and 7SQ2.

R **ON A/C ALL

G. Installation of Waveguide Assembly Parts in Avionics Compartment
(Ref. Fig. 402)
(1)Part 14 :

(a)Remove caps from waveguide switch (6), new waveguide part (14) if necessary and waveguide end (19A).
(b)Clean and inspect waveguide ends (14A), (14B) and (19A), waveguide switch (6) and pressurization window (11).
(c)Position O-rings (12) and pressurization window (11) between aircraft waveguide end (14A) and waveguide switch (6).
(d)Install the four screws (9) and four washers (10) and the two lockwires.
(e)Position O-ring (17) between aircraft waveguide ends (14B) and (19A).
(f)Install the four screws (15) and four washers (16) and the two lockwires.
(g)Tighten all the screws.

(2)Part 19 :
(a)Remove caps from waveguide ends (14B) and (27A) and new waveguide part (19) if necessary.
(b)Clean and inspect waveguide ends (14B), (19A), (19B) and (27A).
(c)Position O-ring (17) between aircraft waveguide ends (14B) and (19A).
(d)Install the four screws (15) and four washers (16) and the two lockwires.
(e)Position O-ring (25) between aircraft waveguide ends (19B) and (27A).
(f)Install the four screws (23) and four washers (26) and the two lockwires.
(g)Position the bushing (22) and the clamp (21).
(h)Install the screw (20) and washer (18).
(i)Tighten all the screws.

(3)Part 27 :
(a)Remove caps from waveguide end (19B), pressure seal (31) and new waveguide part (27) if necessary.
(b)Clean and inspect waveguide ends (19B), (27A) and (27B) and pressure seal (31).
(c)Position O-ring (25) between aircraft waveguide ends (19B) and (27A).
(d)Install the four screws (23) and four washers (26) and the two lockwires.
(e)Position O-ring (29) between aircraft waveguide end (27B) and pressure seal (31).
(f)Install the four screws (28) and four washers (30) and the two lockwires.
(g)Tighten all the screws.

H. Installation of Waveguide Assembly Parts in Radome
(Ref. Fig. 403)

(1)Part 34 :
(a)Remove caps from waveguide end (42A), antenna waveguide window and new waveguide part (34) if necessary.
(b)Clean and inspect waveguide ends (34A), (34B) and (42A) and antenna waveguide window.
(c)Position O-ring (37) between aircraft waveguide end (34A) and antenna waveguide window.
(d)Latch the snap fasteners.
(e)Position O-ring (39) between aircraft waveguide ends (34B) and (42A).
(f)Install the four screws (40) and four washers (41) and the two

lockwires.
(g)Tighten all the screws.
(2)Part 42 :
(a)Remove caps from waveguide ends (34B) and (50A) and new waveguide part (42).
(b)Clean and inspect waveguide ends (34B), (42A), (42B) and (50A).
(c)Position O-ring (39) between aircraft waveguide ends (34B) and (42A).
(d)Install the four screws (40) and four washers (41) and the two lockwires.
(e)Position O-ring (47) between aircraft waveguide ends (42B) and (50A).
(f)Install the four screws (48) and washers (49) and the two lockwires.
(g)Position the bushings (45) and the clamps (43).
(h)Install the screws (44) and washers (46).
(i)Tighten all the screws.
(3)Part 50 :
(a)Remove caps from waveguide end (42B), pressure seal and new waveguide part (50) if necessary.
(b)Clean and inspect waveguide ends (42B), (50A) and (50B) and pressure seal.
(c)Position O-ring (47) between aircraft waveguide ends (42B) and (50A).
(d)Install the four screws (48) and four washers (49) and the two lockwires.
(e)Position O-ring (53) between aircraft waveguide end (50B) and pressure seal.
(f)Install the four screws (51) and four washers (52) and the two lockwires.
(g)Tighten all the screws.

E. Test
Carry out operational test of weather radar transceiver (Ref. 34-41-00, P. Block 501).

F. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.

WEATHER RADAR TRANSCEIVER (1SQ1) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-41-00, P. Block 501	Weather Radar System

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/RADAR TR1	7SQ1	107/C 6

(2)Open access door 121BL to gain access to avionics compartment.

B. Removal

(1)Unscrew knurled nuts (5) and tilt attachment downwards.
(2)Pull weather radar transceiver (2) straight out from rack (1).
(3)Blank electrical connectors (4) and (6).
(4)Remove weather radar transceiver (2).

C. Installation

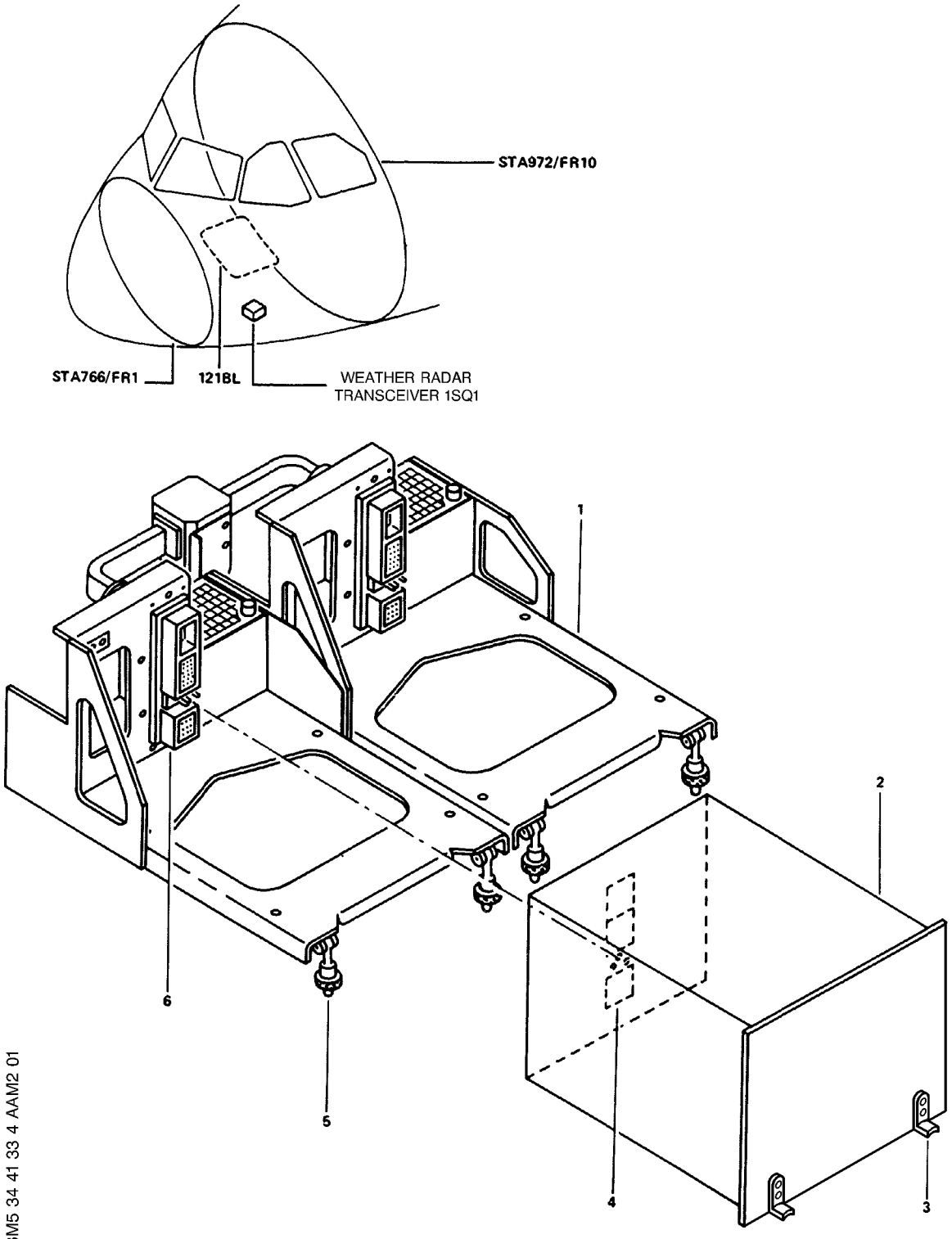
(1)Clean and inspect weather radar transceiver interface and/or adjacent area (fan filter and airplenum in particular).
(2)Remove blanking caps from electrical connectors (4) and (6) and check for correct condition of connectors.
(3)Install weather radar transceiver (2) on rack (1).
(4)Lift knurled nuts (5) into position on studs (3). Tighten.
(5)Remove safety clip and tag and close circuit breaker 7SQ1.

D. Test

Carry out operational test of weather radar transceiver (Ref. 34-41-00, P. Block 501).

E. Close-Up

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.



Weather Radar Transceiver
Figure 401

R

WEATHER RADAR TRANSCEIVER (1SQ1/1SQ2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-41-00, P. Block 501 (Ref. Fig. 401)	Weather Radar System

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

**ON A/C 001-003,

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/RADAR TR1	7SQ1	107/C 6
21VU	RADIO NAV & COM/RADAR TR2	7SQ2	107/C 9

**ON A/C 004-100,

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/RADAR TR1	7SQ1	107/C 6
21VU	RADIO NAV & COM/RADAR TR2	7SQ2	107/C 7

R **ON A/C 001-100,

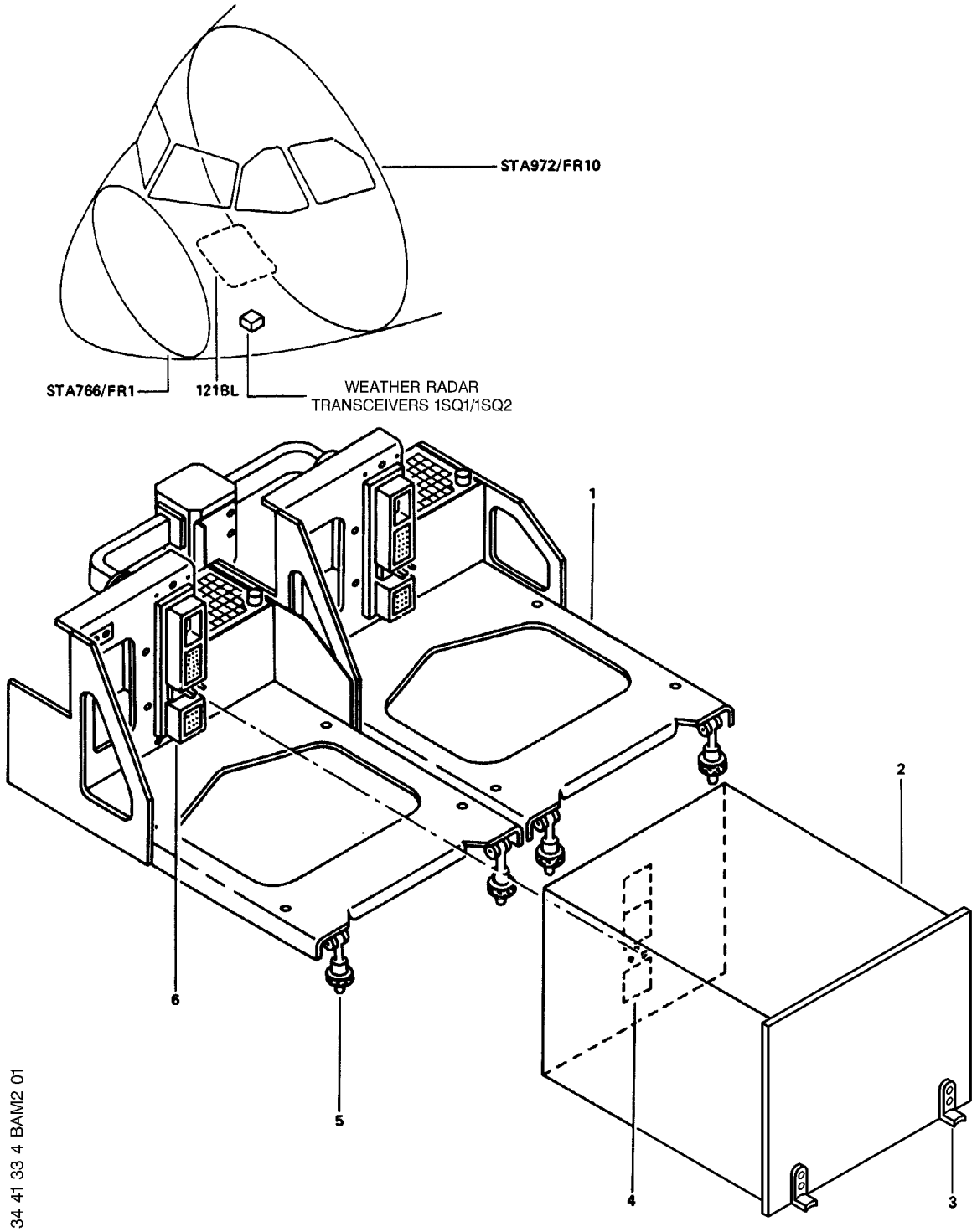
(2)Open access door 121BL to gain access to avionics compartment.

B. Removal

(1)Unscrew knurled nuts (5) and tilt attachment downwards.
(2)Pull weather radar transceiver (2) straight out from rack (1).
(3)Blank electrical connectors (4) and (6).
(4)Remove weather radar transceiver (2).

C. Installation

(1)Clean and inspect weather radar transceiver interface and/or adjacent area (fan filter and airplenum in particular).
(2)Remove blanking caps from electrical connectors (4) and (6) and check for correct condition of connectors.
(3)Install weather radar transceiver (2) on rack (1).
(4)Lift knurled nuts (5) into position on studs (3). Tighten.



Weather Radar Transceiver
Figure 401

(5)Remove safety clips and tags and close circuit breakers 7SQ1 and 7SQ2.

D. Test

Carry out operational test of weather radar transceiver (Ref. 34-41-00, P. Block 501).

E. Close-Up

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Close access door 121BL

RADIO ALTIMETER - DESCRIPTION AND OPERATION

1. General

The function of the radio altimeter is to determine the height of the aircraft above the terrain. One of the main characteristics of the system is that it locks onto the leading edge of the reflected wave, which enables it to measure the distance between the aircraft and the nearest obstacle. It can therefore operate over non-flat ground surface.

The aircraft is equipped with two digital radio altimeters. The digital outputs conform to ARINC characteristic 707.

The radio altimeter operating range exceeds 5000 ft.

The radio altimeter system is made up of two independent systems, each comprising :

- a TRT transceiver
- two identical TRT antennas for transmission and reception.

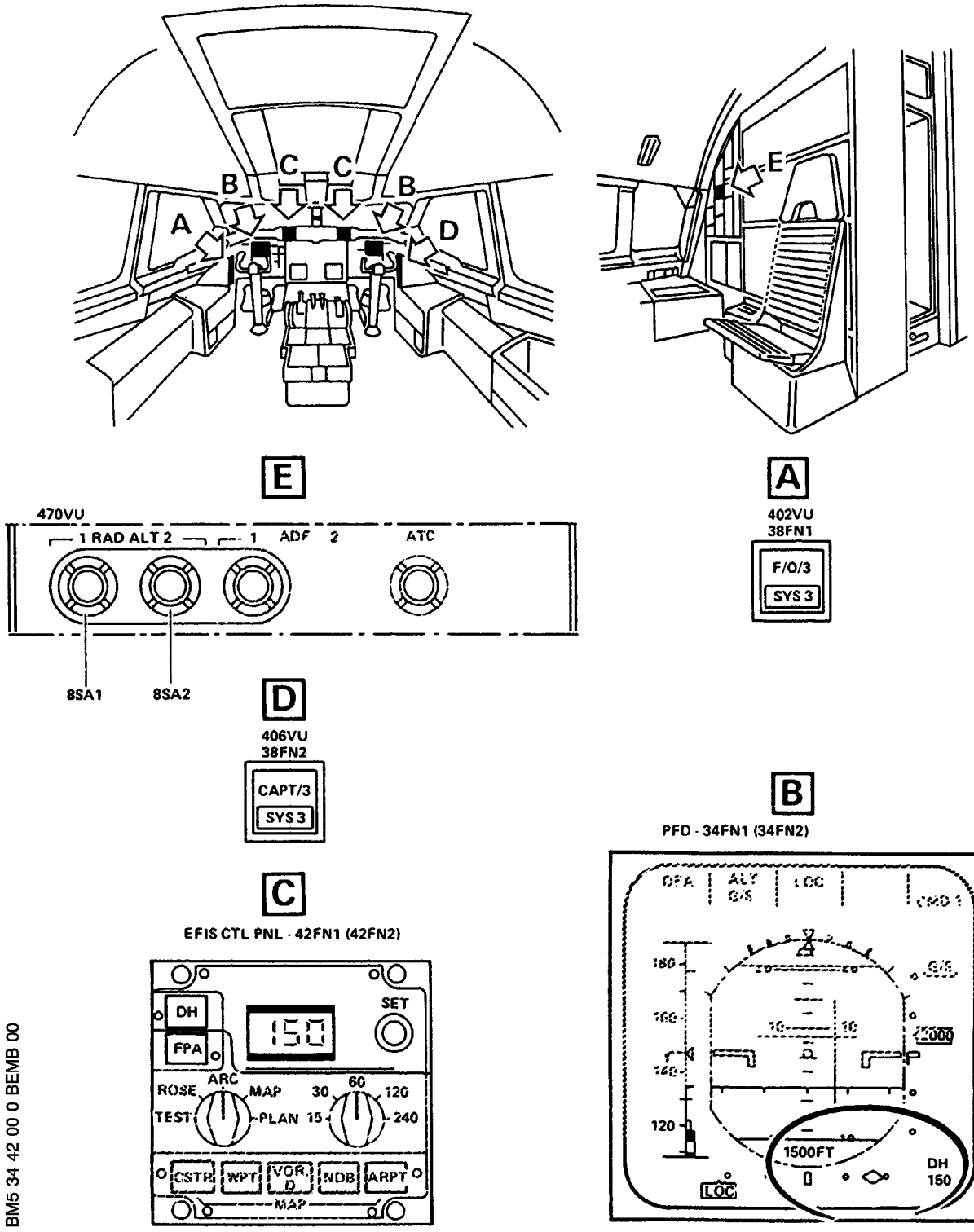
The height and decision height data are displayed on the PFD.

The selection and reading of decision height are performed on the EFIS control panel only.

2. Component Location

(Ref. Fig. 001)

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
1SA1	TRANSCEIVER - RADIO ALTM, 1		152	812	34-42-33
1SA2	TRANSCEIVER - RADIO ALTM, 2		152	812	34-42-33
4SA1	ANTENNA - RA TRANSMISSION, 1		153	812	34-42-11
4SA2	ANTENNA - RA TRANSMISSION, 2		153		34-42-11
5SA1	ANTENNA - RA RECEPTION, 1		153		34-42-11
5SA2	ANTENNA - RA RECEPTION, 2		154		34-42-11
8SA1	P/BSW - AVIONICS SYS TEST/RAD ALT, 1	470VU	212		
8SA2	P/BSW - AVIONICS SYS TEST/RAD ALT, 2	470VU	212		
9SA1	FAN - RA TRANSCEIVER 1		152	812	34-42-43
9SA2	FAN - RA TRANSCEIVER 2		152	812	34-42-43
34FN1	PFD - CAPT	3VU	211		34-74-22
34FN2	PFD- F/O	5VU	212		34-74-22
38FN1	P/BSW - EFIS SGU - CAPT	402VU	211		
38FN2	P/BSW - EFIS SGU - F/O	406VU	212		
42FN1	CTL PNL EFIS, CAPT	13VU	210		34-73-17
42FN2	CTL PNL EFIS, F/O	13VU	210		34-73-17



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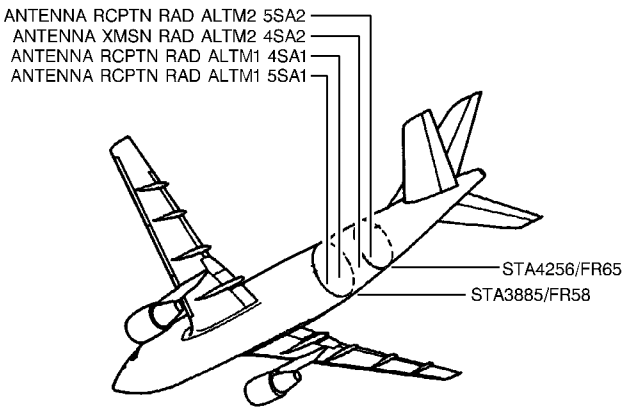
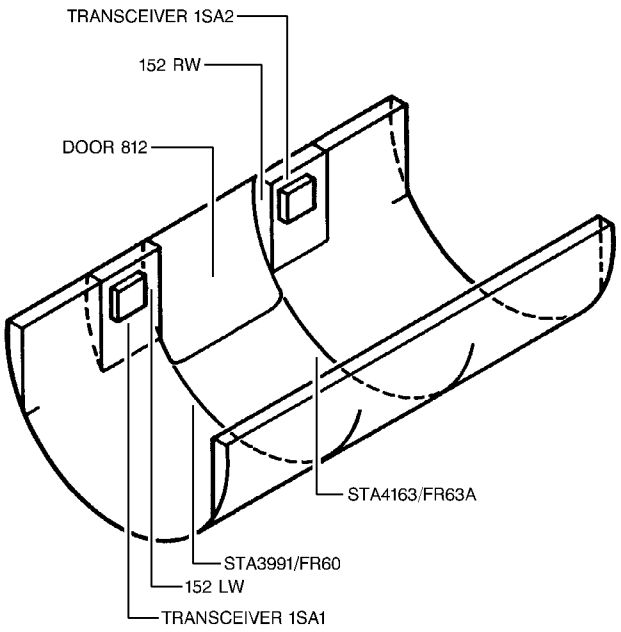
Radio Altimeter - Component Location - Sheet 1/2
Figure 001





BM5 34 42 00 0 BEMM 01

Radio Altimeter - Component Location - Sheet 2/2
Figure 001

3. System Description
(Ref. Fig. 002)
The aircraft is equipped with two identical radio altimeter systems, each comprising.

A. A transceiver 1SA1 (1SA2) which generates transmission signals and uses the reception signal to obtain distance information with respect to the ground below.

B. Effective Height is displayed on Capt and F/O Radio Altimeter Indicators 11SA1 and 11SA2. It is indicated by a fixed index on a moving vertically scaled tape.

C. Effective height and decision height are displayed on the PFD, respectively located on the lower part of the sphere and the lower right corner of the PFD.

D. A transmission antenna 4SA1 (4SA2) for transmitting signals to the ground.

E. A reception antenna 5SA1 (5SA2) which receives the transmitted signals reflected from the ground below.

F. A circuit breaker 7SA1 (7SA2) through which the transceiver 1(2) and the indicator 1(2) are supplied with 115VAC.

G. Two tranceiver cooling fans 9SA1 and 9SA2.

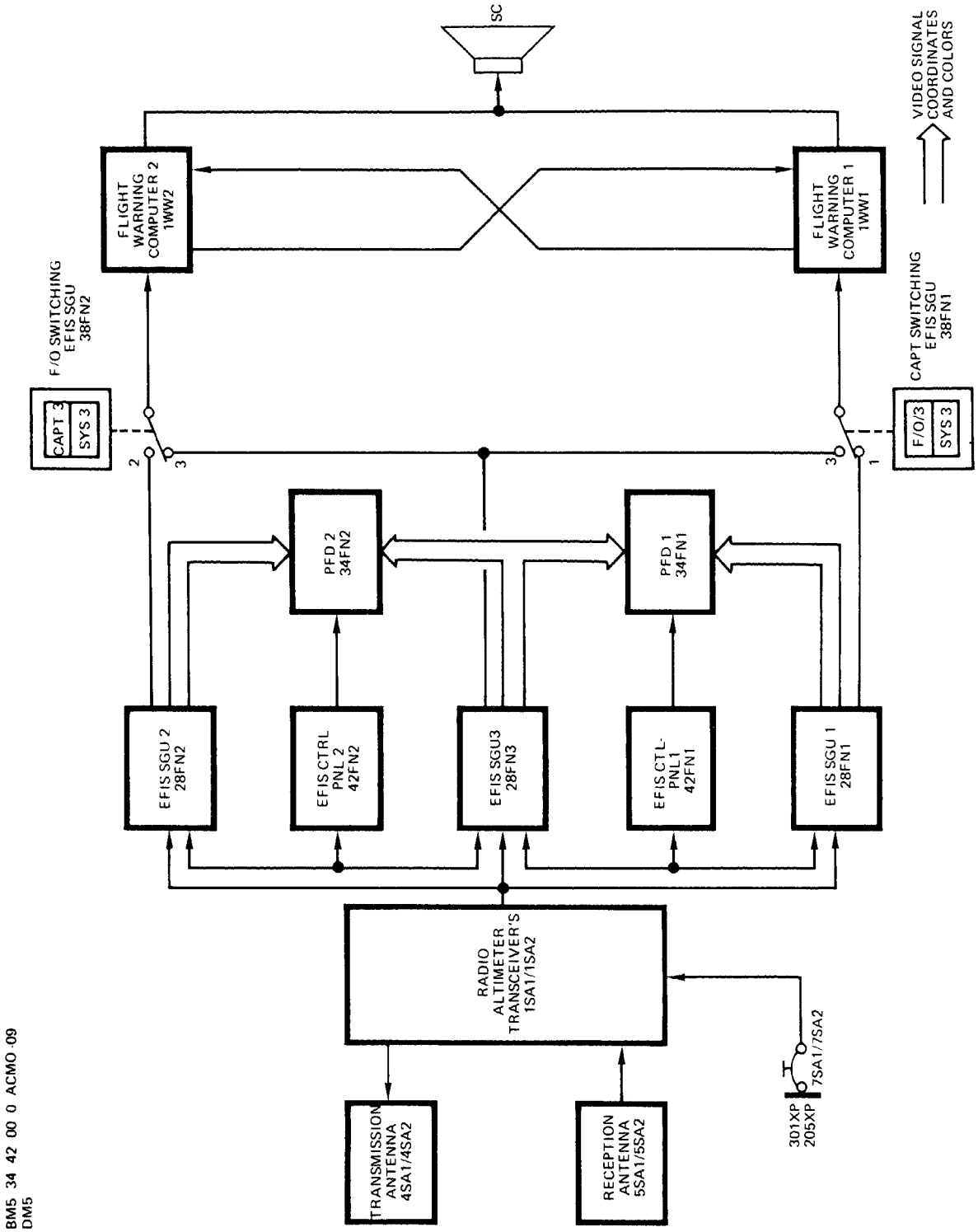
4. Component Description

A. Transceiver 1SA1 (1SA2)
(1)External description
(Ref. Fig. 003)
(a)The transceiver face features :
- a connector (TEST CONN) to connect test set for system test
- a TEST pusbutton switch. Pressing it activates the functional self-test.
- one LED to indicate no failure (SYSTEM OK).
- three LEDS to indicate failure on antenna (ANT), indicating (IND) and reception-transmission (R/T UNIT) circuits, until the TEST pushbutton switch is released.

RED (FAIL)	GREEN (OK)	
OFF	ON	Unit currently checks good
ON	OFF	Unit currently checks bad. (Unconditional pull).

- two fasteners for securing the transceiver in its mount.
- a handle.

(b)The back features :
a connector for connection of the transceiver to the aircraft electrical network.
(2)Principle of operation
(Ref. Fig. 004)



BM5 34 42 00 0 ACMO 09
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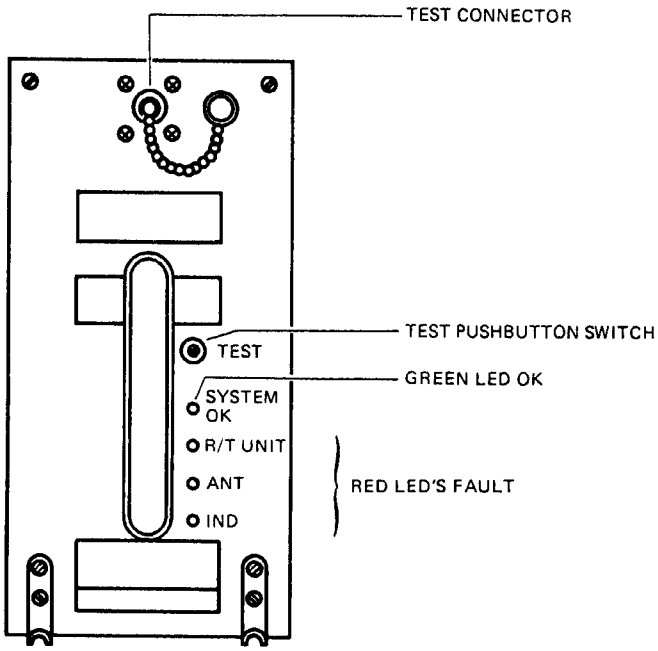
Radio Altimeter - Block Diagram
Figure 002



TRANSCEIVER FACE

DM5 34 42 00 0 ADMO 09
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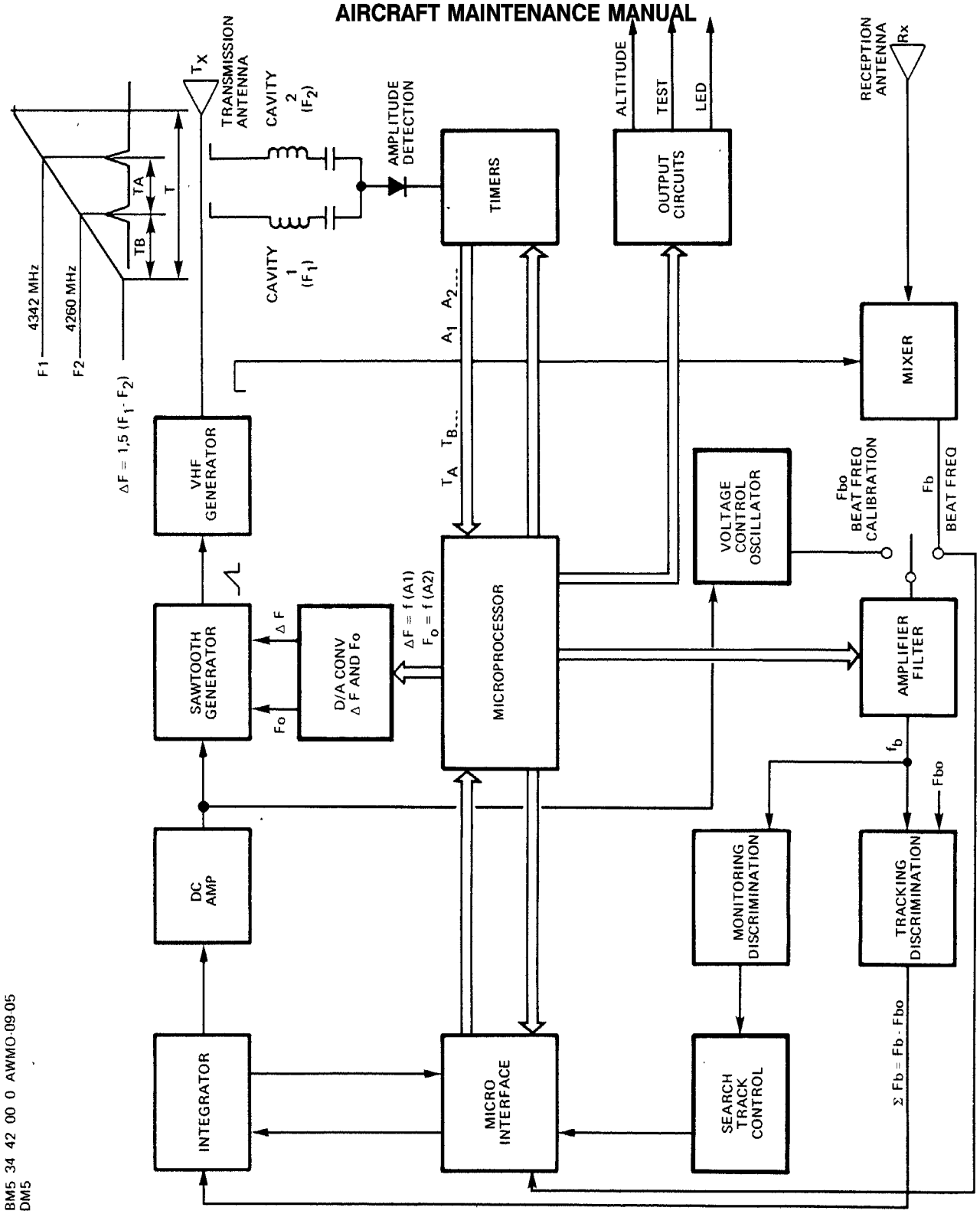
Transceiver Face
Figure 003



Radio Altimeter Transceiver - Functional Block Diagram
Figure 004

(Ref. Fig. 005)

(a)Layout

The transmitted wave Tx is mixed with the reflected wave Rx to provide several beat frequencies the weakest of which alone is selected after separation in the amplifier filter.

The tracking discriminator generates an error signal eFb (eFb = Fb - Fbo) serving to modify the sawtooth wave so as to obtain a correct Fb ; the sawtooth generator modifies the slope of the sawtooth the amplitude of which is constant.

The purpose of the monitoring discriminator is to ensure that the Fb spectrum is definitely centered on the Fbo.

In the absence of this spectrum, the monitoring discriminator switches the search track control to search mode. The wave is then transmitted in sawtooth form. The search cycle duration is 0.4 seconds and repeats until Fb is correct.

The energy detected by the monitoring discriminator is then sufficient to exceed a preset threshold and the monitoring discriminator performs switching to track mode.

(b)Monitoring

The radio altimeter is permanently monitored by the monitoring discriminator. In addition, calibration is performed twice per second.

During calibration :

- the mixer is cut off and the amplifier filter output signal is no longer present.
- the monitoring discriminator triggers the search mode.
- a second source known as the test source is set into operation and injects an input signal into the amplifier filter.

When Fb = Fbo (25 KHz), search is cut off by the monitoring discriminator.

The sawtooth generator, which has the same input as the test source, generates a 1 ms sawtooth and the microprocessor calibrates ΔF and Fo. the calibration test is then completed.

B. Radio Altimeter Displays

(1)Height data display on the PFD 34FN1 (34FN2)

(Ref. Fig. 006)

The aircraft height and decision height, with respect to the ground, are displayed in the PFD sector 2, for height less than or equal to 2500ft.

(2)Decision height display on the EFIS Control Panel 42FN1 (42FN2)

(Ref. Fig. 007)

DH function is selected and read on the upper part of the EFIS Control Panel 42FN1 (42FN2).

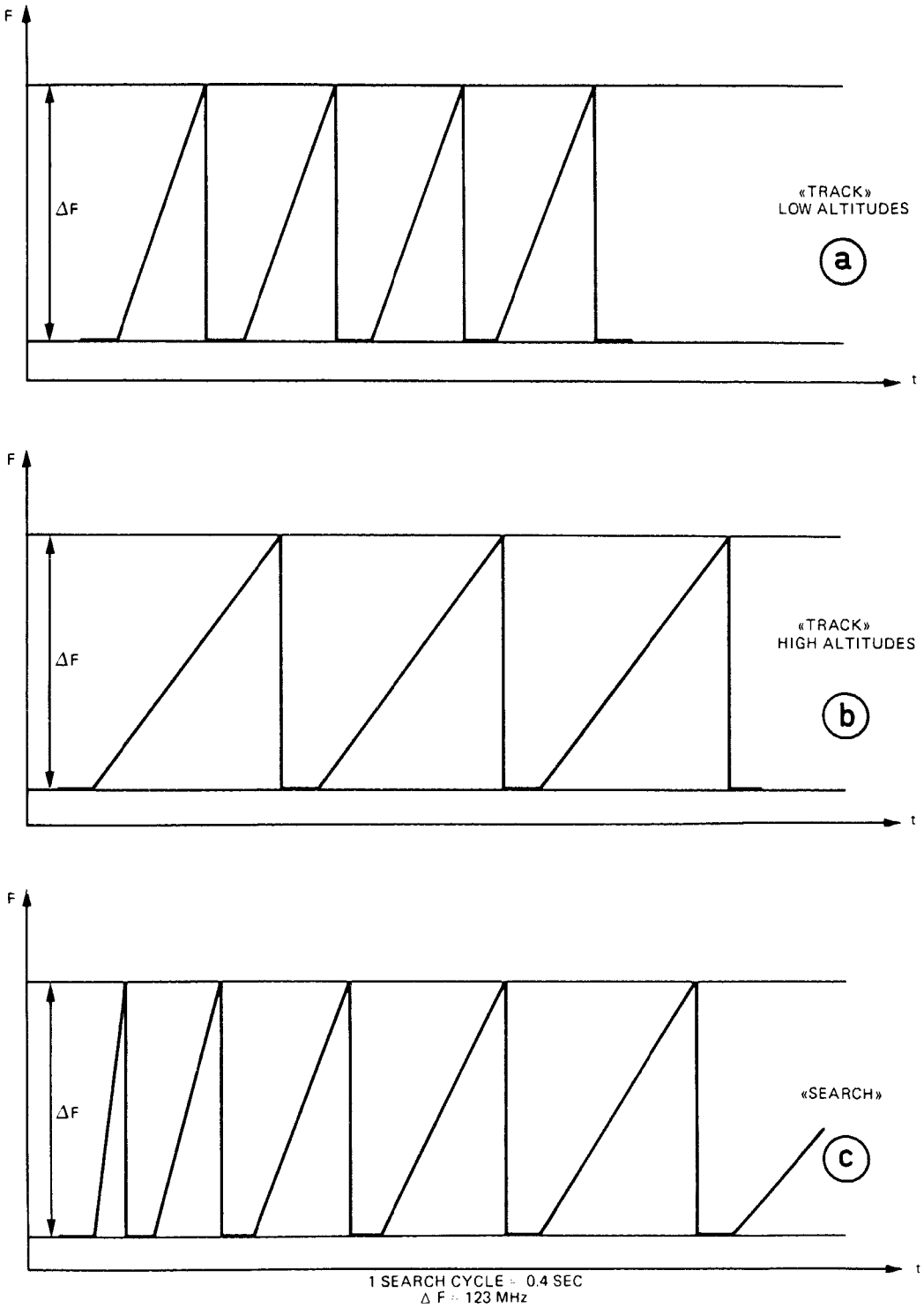
The selection mode is shown in figure (Ref. Fig. 007).

C. Antennas 4SA1 (4SA2) and 5SA1 (5SA2)

(Ref. Fig. 008)

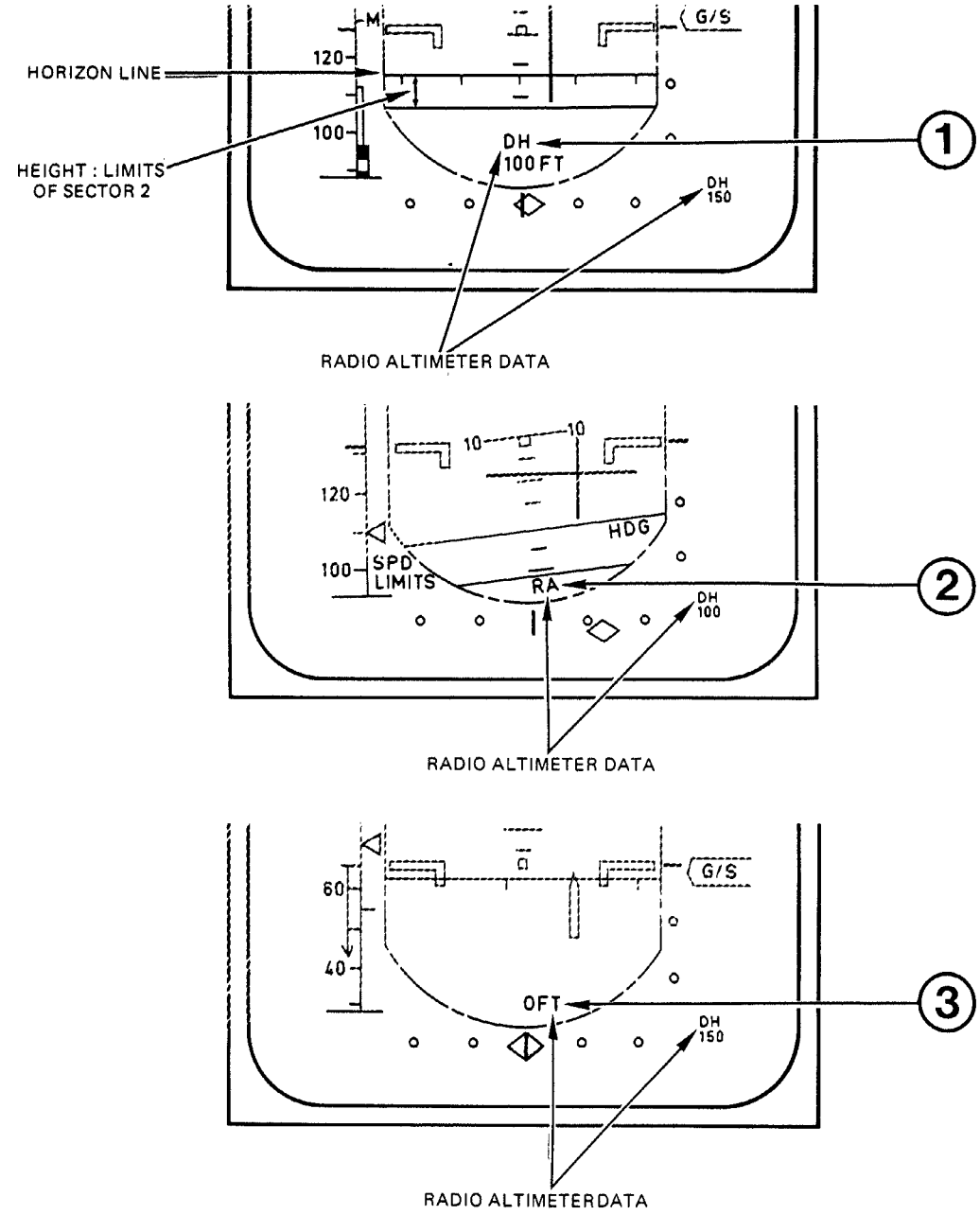
The transmission and reception antennas are identical. Each antenna is of the type "microstrip". The microstrip antenna is installed on the skin of the aircraft and fixed by four screws, sealing is by an O-ring.

Each antenna is supplied through a coaxial connector linked to the



BM5 34 42 00 0 AUMO 08 03
DM5

Radiated Wave Form
Figure 005



-1- DH ALERT MESSAGE :
THIS MAGENTA DH MESSAGE APPEARS WHEN THE RADIO HEIGHT IS LESS THAN THE DECISION HEIGHT.

-2- RADIO ALTIMETER FAILURE WARNING MESSAGE
THIS RED RA WARNING MESSAGE APPEARS WHEN BOTH RADIO ALTIMETER SYSTEMS HAVE FAILED

-3- RADIO HEIGHT - ROLL OUT INDICATION :
JUST AFTER TOUCH DOWN: RADIO HEIGHT IS 0 FT. AND THE MAGENTA DH ALERT MESSAGE DISAPPEARS FROM THE SPHERE.

BM5 34 42 00 0 RJMO 08 03
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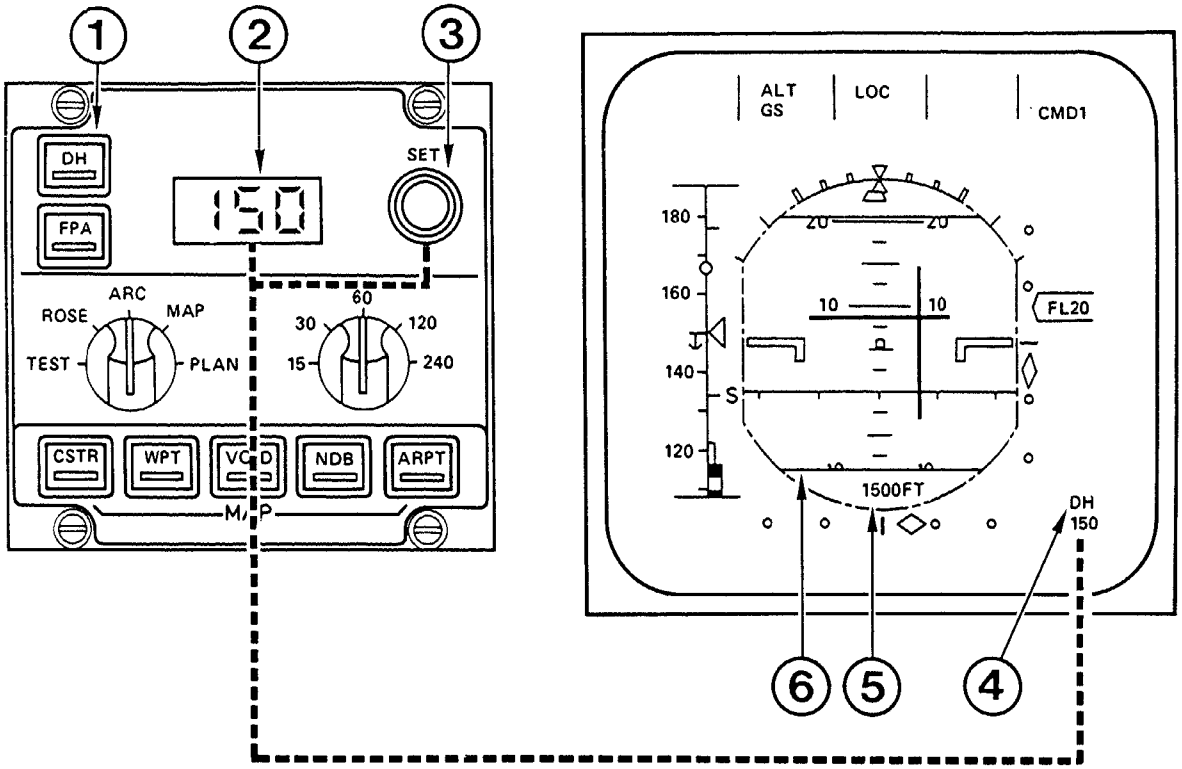
PFD - Radio Altimeter Displays
Figure 006



1- DH PUSHBUTTON SWITCH :
WHEN IT IS PRESSED, THE LOWER STRIP ILLUMINATES GREEN AND THE DECISION HEIGHT IS DISPLAYED IN THE WINDOW USING SET KNOB.

2- DISPLAY WINDOW :
DISPLAYS DECISION HEIGHT OR FPA, DEPENDING ON THE SELECTION, AND IS CONTROLLED BY THE SET KNOB.

3- SET KNOB :
THIS DUAL KNOB ENABLES THE SETTING OF DECISION HEIGHT OR FPA ON THE DISPLAY WINDOW

4- DH ANNUNCIATOR :
THIS INDICATION IS CONTROLLED BY THE EFIS CONTROL PANEL. THE VALUE IS LIMITED TO 995 FEET.

5- RADIO HEIGHT INDICATION :
FOR ALTITUDES OF DH 100 FEET AND ABOVE, THE INDICATION IS GREEN, AND BELOW THIS VALUE, IT IS AMBER.

6- RADIO HEIGHT SCALE :
JUST BEFORE TOUCH DOWN, THE PITCH SCALE IS ERASED ON THE LOWER SPHERE, AND A RADIO HEIGHT SCALE IS PRESENTED, THE DISTANCE BETWEEN TWO CONSECUTIVE GRADUATIONS DEPENDS ON THE RADIO HEIGHT.

BM5 34 42 00 0 RLMO 13 08
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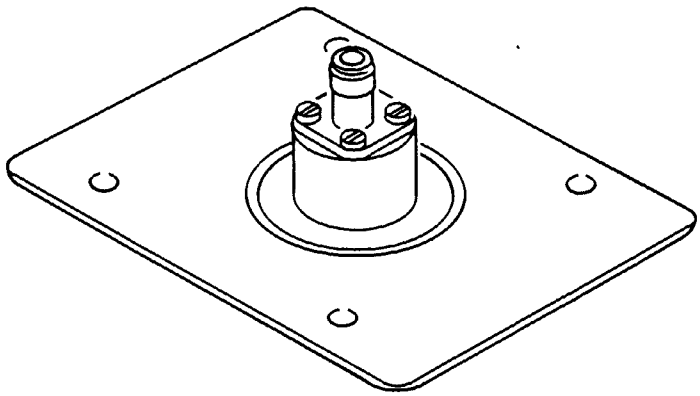
PFD - Approach Before Glide Capture
Figure 007



BM5 34 42 00 0 AMH0.13

Radio Altimeter - Antenna
Figure 008

transceiver.

D. Fans 9SA1 (9SA2)
The six-blade fan is integral with a removable base plate attached under the transceiver mount. It is contained in a square aluminium alloy case. It is supplied with 115VAC through a connector and associated wiring connecting it to the transceiver. Parasites are suppressed by a capacitor mounted on the fan case.

5. Overall System Operation

**ON A/C 001-004,

(Ref. Fig. 009)

**ON A/C 005-100,

(Ref. Fig. 010)

R **ON A/C 001-100,

A. Transceivers Power Supply
(Ref. Fig. 011)
Both systems are supplied as soon as normal 115 volts, 400 Hz buses are powered.
(1)Radio altimeter system No.1 1SA1
The transceiver No.1 is supplied from ESS bus 301XP through circuit breaker 7SA1 located on panel 21VU.
(2)Radio altimeter system No.2 1SA2
The transceiver No.2 is supplied from normal bus 205XP through circuit breaker 7SA2 located on panel 21VU.
The power consumption of each transceiver is 28W.

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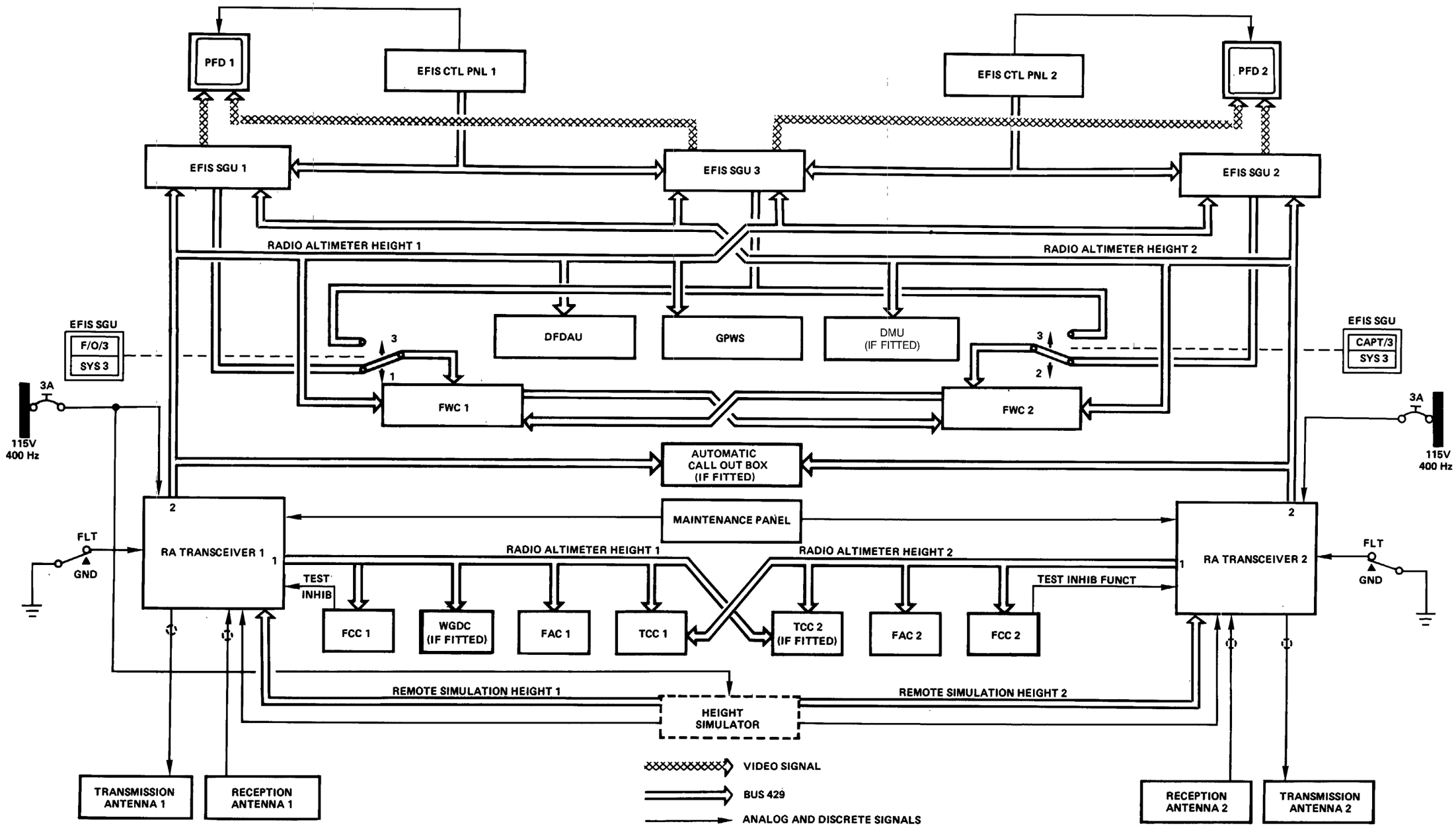
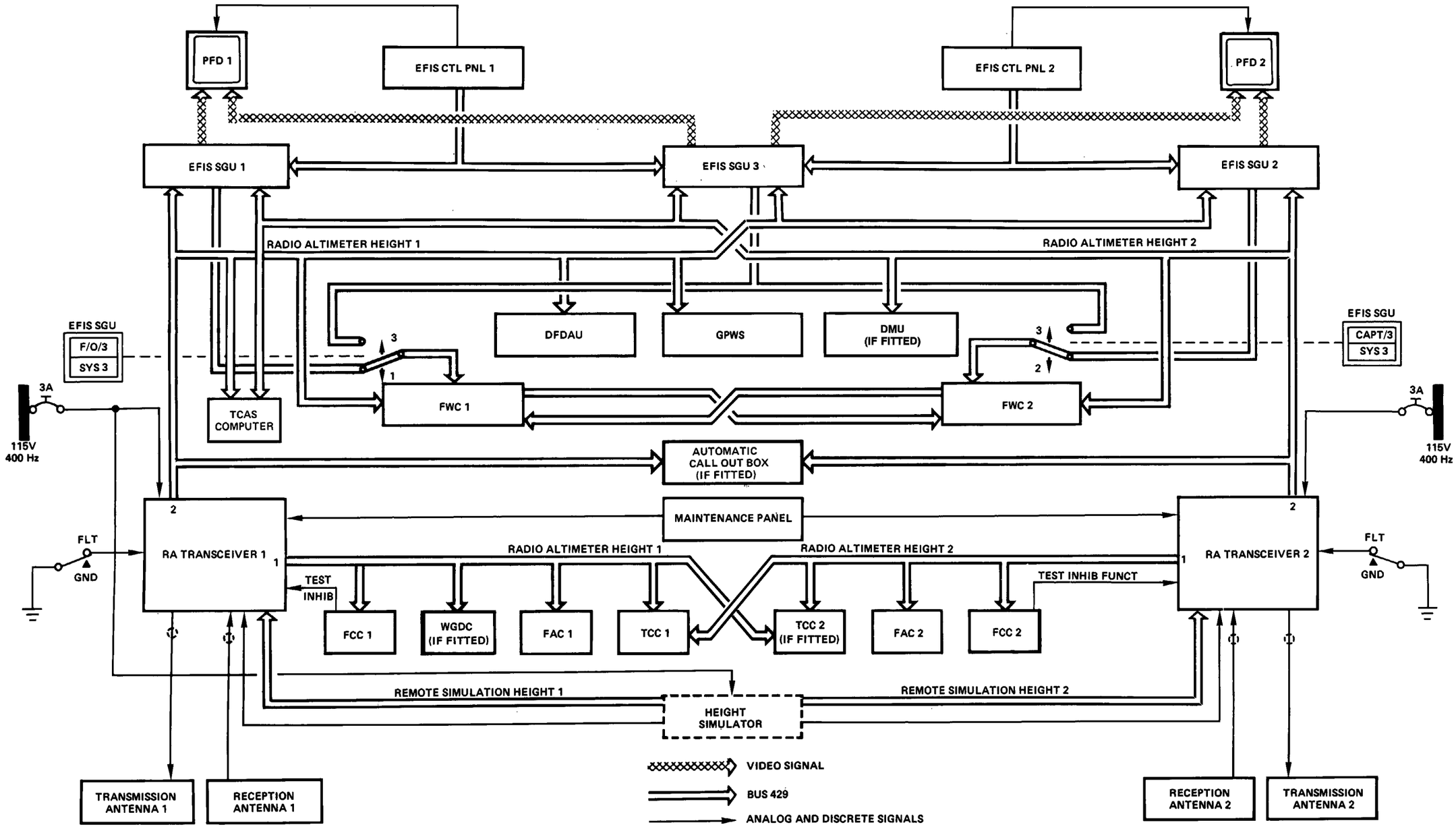


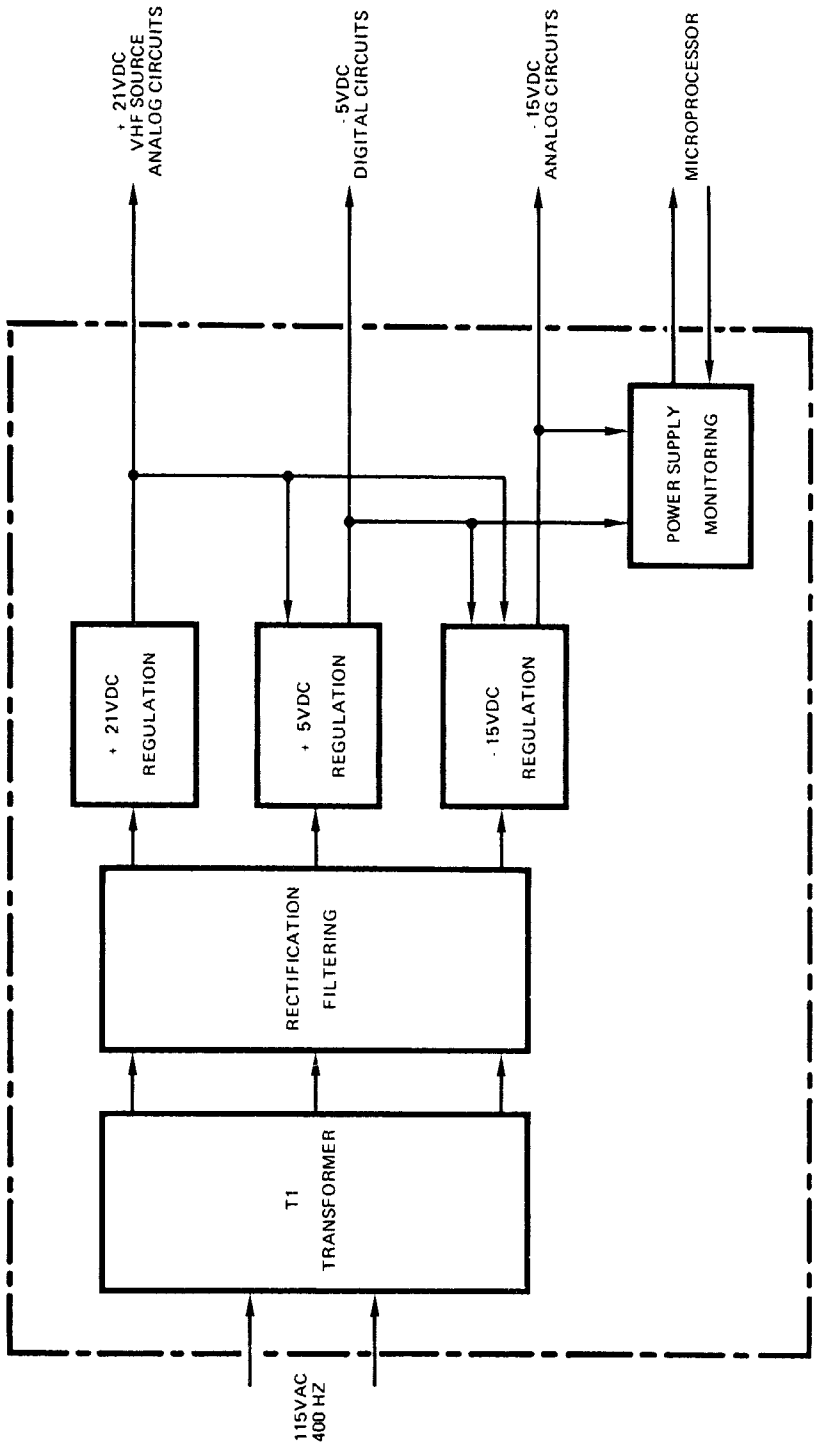
BM5 34 42 00 0 AMS0 01

Radio Altimeter System - Functional Interconnection
Figure 009



BM5 34 42 00 0 AMB0 01

Radio Altimeter System - Functional Interconnection
Figure 010



DM5 34 42 00 0 AOM0 03-08
BM5

Radio Altimeter System - Power Supply
Figure 011

B. Data Display

(1)Height data

The aircraft height with respect to the ground is displayed in the PFD sector 2, for heights less than or equal to 2500 ft.
The dimensions and color of digits vary as a function of height and decision height, as follows :

- H ≥ 1000 : 4 mm (0.156 in.) green digits
- H < 1000 : 5 mm (0.195 in.) green digits (only if DH + 100 < 1000)
- H < DH + 100 : 5 mm (0.195 in.) amber digits.

The sensitivity of the display is also a function of height :

- H > 50 ft. : 10 ft. increments
- 5 ≤ H ≤ 50 ft. : 5 ft. increments
- H < 5 ft. : 1 ft. increments

In case of failure of the radio altimeter being used, switching to the other instruments is automatically performed. The failed system is indicated on the left ECAM display unit.
In case of failure of both radio altimeters, the digits disappear and are replaced by a red RA failure warning message (5 mm (0.195 in.) red digits) which flashes during three seconds, then remains on.
The RA message is displayed in slats extended configuration only (the bit 11 of the word 274 in FAC is set to zero).

(2)Decision height (DH) data

It is displayed in the RH lower corner of the PFD (3 mm (0.117 in.) high dark blue digits), as soon as the radio altimeter is in operation (that is when H ≤ 2500 ft.). When the height is lower than the decision height, an amber DH alert message (6 mm (0.234 in.)) is displayed above sector 2. (This indication must be inhibited at take-off). In case of failure, DH data is not displayed; it is replaced by a red DH failure warning message which flashes during 3 seconds, then remains on in the RH lower corner of the PFD.

(3)Approach

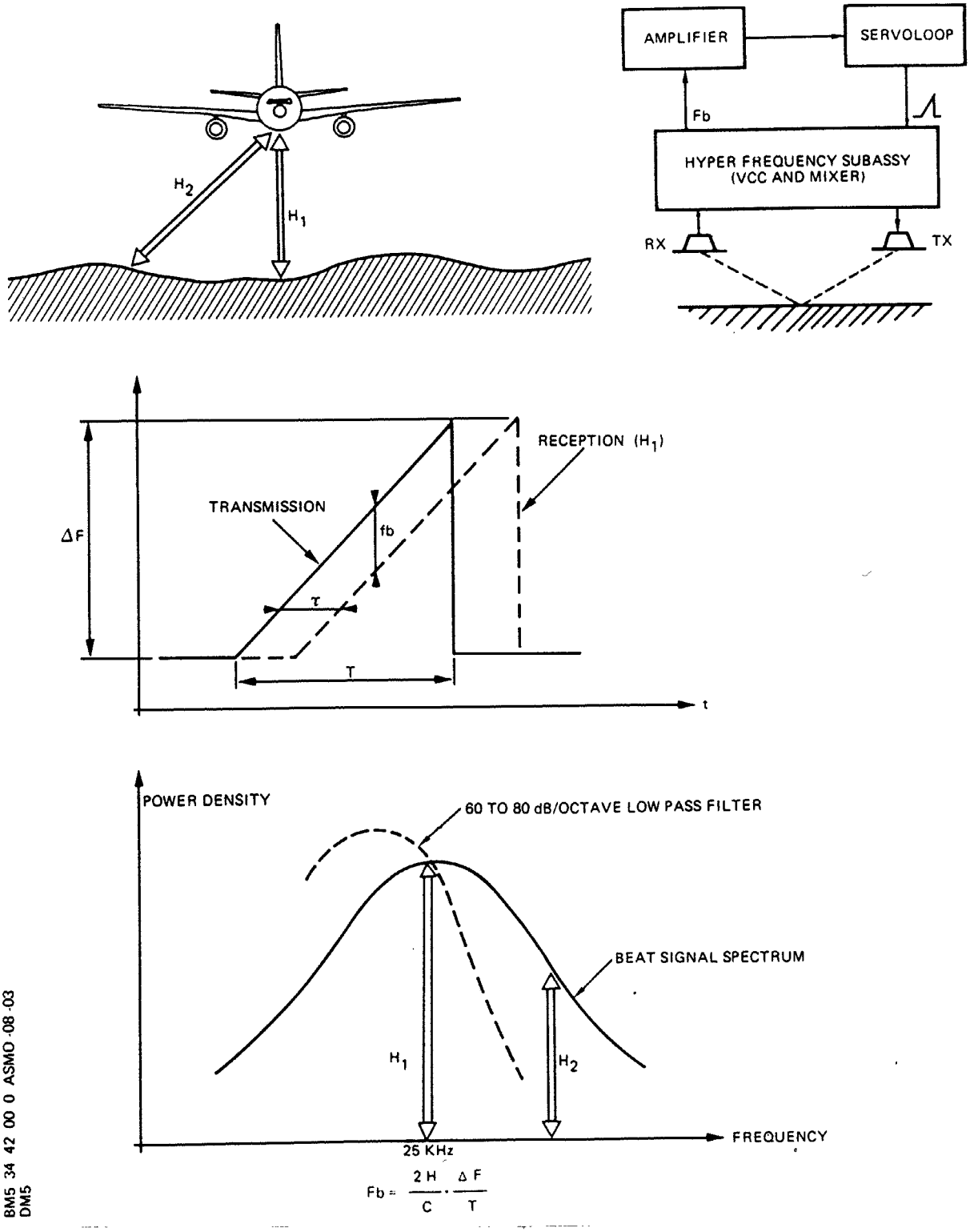
Below 300 ft. in the PFD, the height is represented by the distance between the horizon line and the limit of sector 2 which moves upwards, in relation to, and just below the horizon line (sensitivity : 1 mm for 10 ft.). As it moves upwards, the limit of sector 2 masks the graduations on the lower sphere.
In case of failure of the radio altimeter, this data disappears.

C. Radio Altimeter Test

On CAPT and F/O EFIS control panels select a decision height of 040 feet. DH alert message and same DH value are displayed on CAPT and F/O PFDs. On flight compartment maintenance panel press and hold (10 seconds) RAD ALT 1 (RAD ALT 2) pushbutton switch. On CAPT PFD (F/O PFD) the test value 40 ± 5 ft. is displayed until switch is released. Release RAD ALT 1 (RAD ALT 2) pushbutton switch, the RA test value drops to "0 foot" and the DH alert message is displayed again. On CAPT and F/O EFIS control panels release DH pushbutton switch.

6. Operation

A. Theory of Operation
(Ref. Fig. 012)
The height of the aircraft above the ground is measured by the time taken for the round trip of a wave transmitted by the aircraft, reflected by the ground and then captured by the aircraft.
In practice, the time elapsed is computed between the transmitted wave and the reflected wave. The time Tau is associated with the height H of the aircraft by the relationship :
Tau = 2H/C or H = Tau x C/2,
where C is the Velocity of the wave.
10µs is equivalent to 5000 ft... Accuracy is greatly improved by reducing the measurement to that of the period T of a sawtooth wave.
In fact, the transmission frequency and therefore the reception frequency vary linearly with a two sawtooth pattern on which are imposed two clearly defined features :
- A constant amplitude ΔF (123 MHz)
- A constant beat frequency Fb (25 KHz).
10µs is therefore equivalent to 1 ft. (T = 4920 Tau).
Wherefrom constant amplitude sawtooth is obtained with period T directly related to altitude. In search mode, there is a sweep of period T until an Fb of 25 KHz is obtained.
Moreover the TRT radio altimeter is of the leading edge tracking type, denoting locking onto the leading edge of the wave, so that when there are several reflected waves, the radio altimeter picks up the wave with the shortest path, implying the distance to the nearest obstacle.
The nearest point produces the smallest beat frequency and other points, higher frequencies. Since it is desirable, for accuracy and aircraft safety to measure the distance to the nearest point, the low pass filter after the amplifier removes the frequencies above 25 KHz and therefore the slant path energy. This filter has a slope of 60 to 80 dB/octave.



Radio Altimeter - Principle Of Operation
Figure 012

B. Radio Altimeter Bite Test
On radio altimeter transceiver face press and hold TEST pushbutton switch. All four LEDs should come on for approximately 1 second to verify their operation and then go off.
1 second later, the green SYSTEM OK LED should come on indicating the unit checks good.

7. Interfaces
The radio altimeter provides information of the radio height to the following systems :
The label used and its characteristics are provided in the table below :

LABEL	PARAMETER	UNIT	RANGE	SIGN BIT NB	RESOLUTION	MIN. T INTERVAL	MAX. T INTERVAL
164	Radio height	Ft.	8192	16	0.125	25	50

- DFDAU (Digital Flight Data Acquisition Unit)
- GPWC (Ground Proximity Warning Computer)
- FWC (Flight Warning Computer)
- SGU (Symbol Generator Unit)
- PFD (Primary Flight Display)

**ON A/C 005-100,

- TCAS Computer (Traffic Collision Avoidance System)

RADIO ALTIMETER - DESCRIPTION AND OPERATION

1. General

The radio altimeter system provides altitude data for use in controlling all-weather landing and low-altitude flight systems. It gives the crew a precise indication of the altitude of the aircraft in relation to the terrain over which it is flying, irrespective of atmospheric pressure.

R The aircraft is equipped with two digital radio altimeters. The digital outputs conform to ARINC characteristics 707.

The radio altimeter range is from the ground altitude to 5000 ft.

The radio altimeter system is made up of two independent systems, each comprising :

- a transceiver
- Two identical antennas, for transmission and reception. The height and decision height data is displayed on the PFD.

The selection and reading of decision height are performed on the EFIS COntrol Panel only.

2. Component Location

RADIO ALTIMETER

R (Ref. Fig. 001)

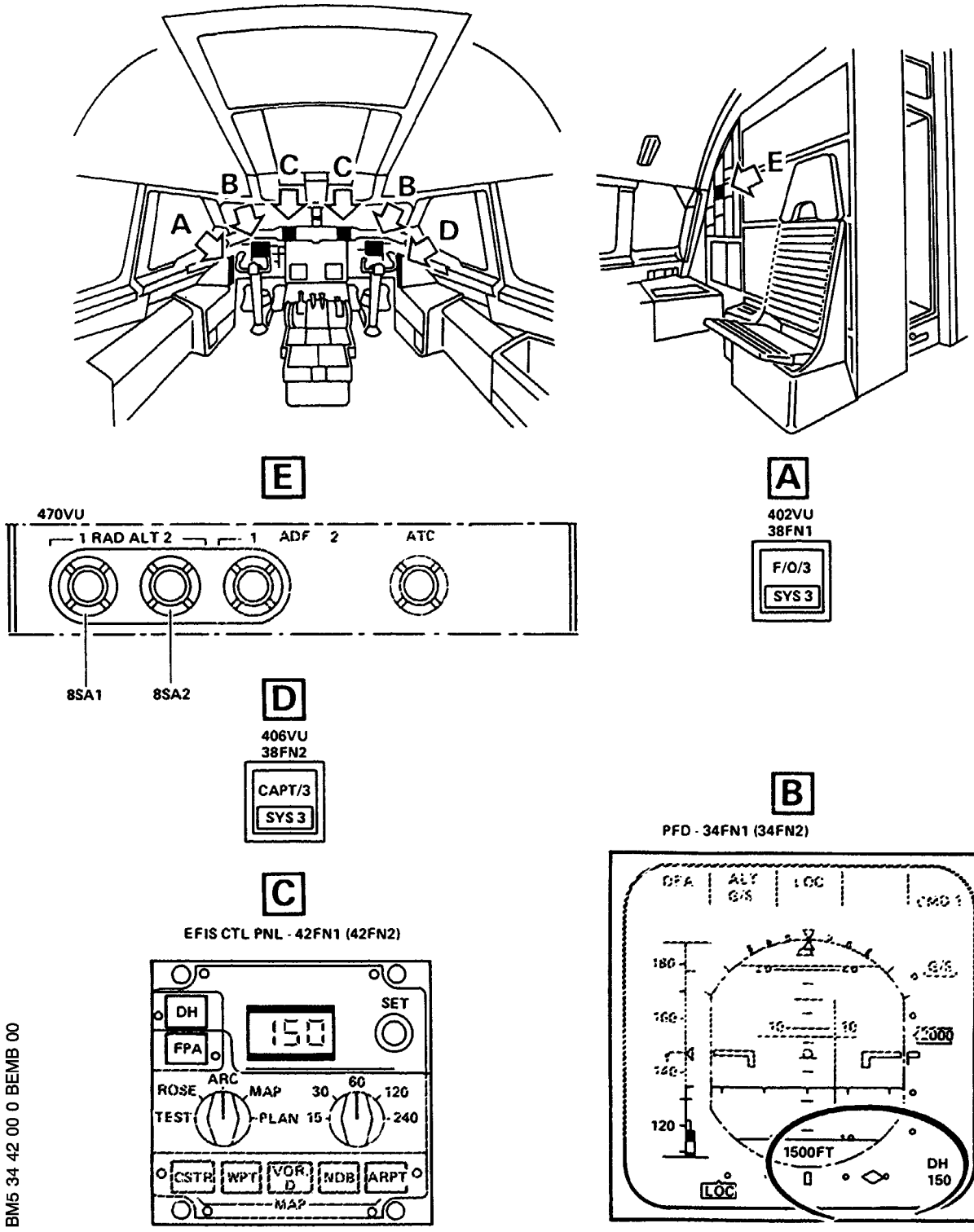
FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
1SA1	TRANSCEIVER - RADIO ALTM, 1		152	812	34-42-33
1SA2	TRANSCEIVER - RADIO ALTM, 2		152	812	34-42-33
4SA1	ANTENNA - RA TRANSMISSION, 1		153		34-42-11
4SA2	ANTENNA - RA TRANSMISSION, 2		153		34-42-11
5SA1	ANTENNA - RA RECEPTION, 1		153		34-42-11
5SA2	ANTENNA - RA RECEPTION, 2		154		34-42-11
8SA1	P/BSW - AVIONICS SYS TEST/RAD ALT, 1	470VU	212		
8SA2	P/BSW - AVIONICS SYS TEST/RAD ALT, 2	470VU	212		
9SA1	FAN - RAD ALT, 1		152	812	34-42-43
9SA2	FAN - RAD ALT, 2		152	812	34-42-43
34FN1	PFD - CAPT	3VU	211		34-74-22
34FN2	PFD - F/O	5VU	212		34-74-22
38FN1	P/BSW - EFIS SGU, CAPT	402VU	211		
38FN2	P/BSW - EFIS SGU, F/O	406VU	212		
42FN1	CTL PNL - EFIS, CAPT	13VU	210		34-73-11
42FN2	CTL PNL - EFIS, F/O	13VU	210		34-73-11

3. System Description

(Ref. Fig. 002)

The aircraft is equipped with two identical radio altimeter systems, each comprising :

A. A transceiver 1SA1 (1SA2) which generates transmission signals and uses the reception signal to obtain distance information with respect to the ground below.



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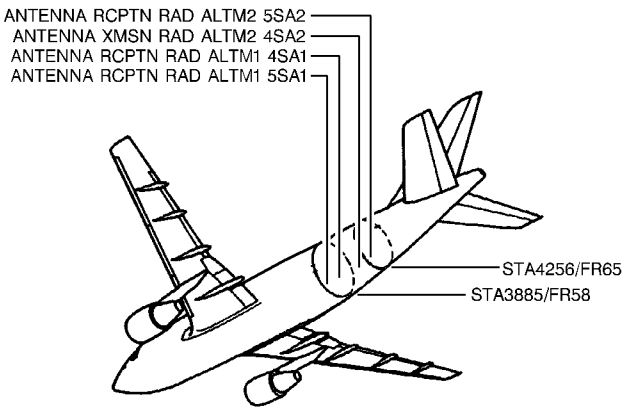
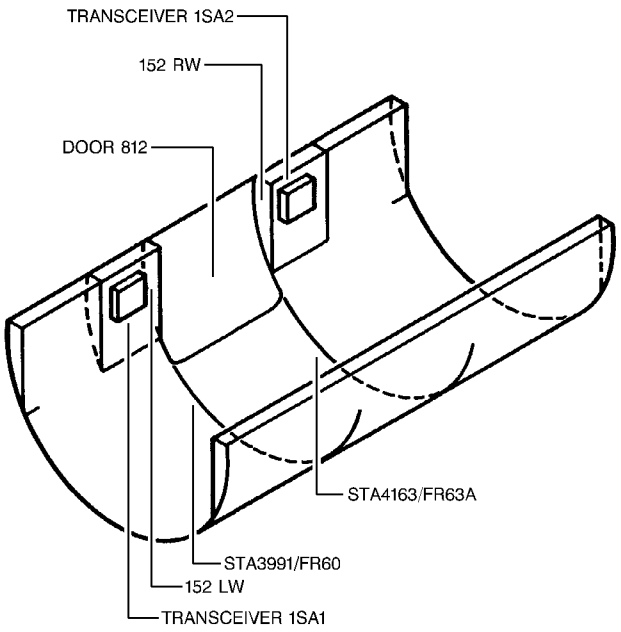
Radio Altimeter - Component Location - Sheet 1/2
Figure 001

R

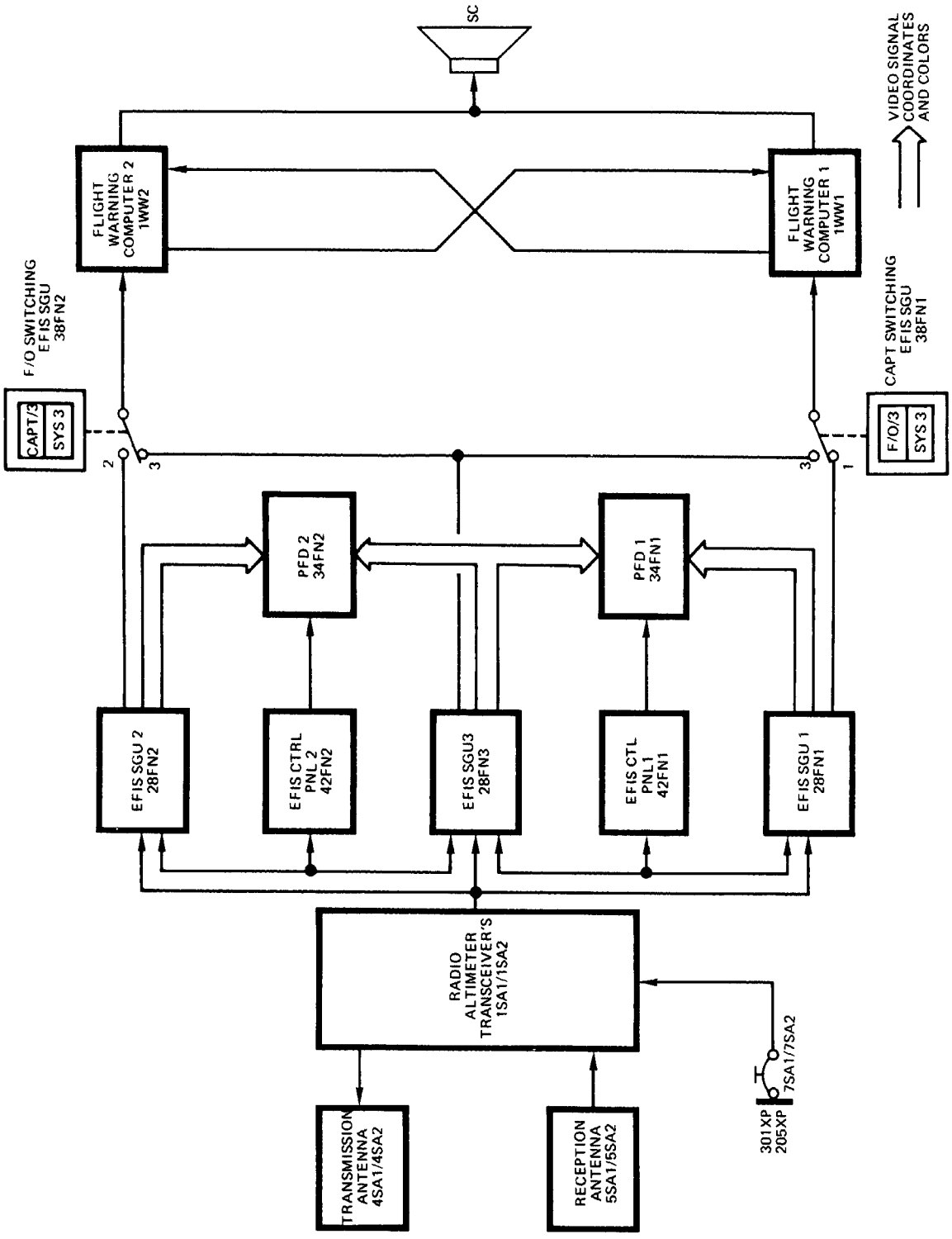




BM5 34 42 00 0 BEMM 01

Radio Altimeter - Component Location - Sheet 2/2
Figure 001

R



Radio Altimeter - Block Diagram
Figure 002

B. Effective height and decision height are displayed on the PFD, respectively located on the lower part and the lower right part of the PFD.

C. A transmission antenna 4SA1 (4SA2) for transmitting signals to the ground.

D. A reception antenna 5SA1 (5SA2) which receives the transmitted signals reflected from the ground below.

E. A circuit breaker 7SA1 (7SA2) through which the transceiver is supplied with 115VAC.

F. Two transceiver cooling fans 9SA1 and 9SA2.

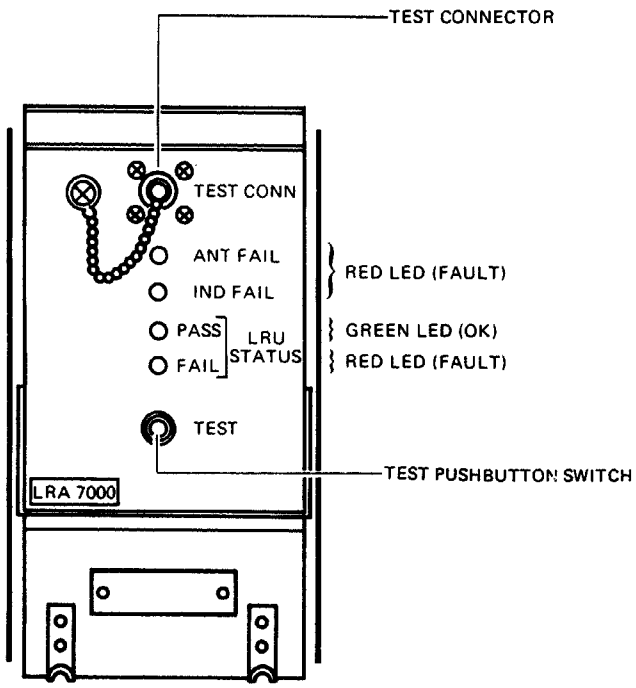
4. Component Description

A. Transceiver 1SA1 (1SA2)
(1)Description
(Ref. Fig. 003)
(a)The transceiver face features
- a connector (TEST CONN) to connect test set for system test.
- a TEST pushbutton switch. Pressing it activates the functional self-test.
- four LEDs to indicate failure on antenna (ANT), indicating (IND) and reception-transmission (LRU STATUS) circuits, until the TEST pushbutton switch is released.

LRU STATUS : RED (FAIL)	GREEN (PASS)	
OFF	ON	Unit currently checks good.
ON	OFF	Unit currently checks bad. (Unconditional pull).
ON	ON	Undefined combination.
OFF	OFF	(Pull unit if it occurs).

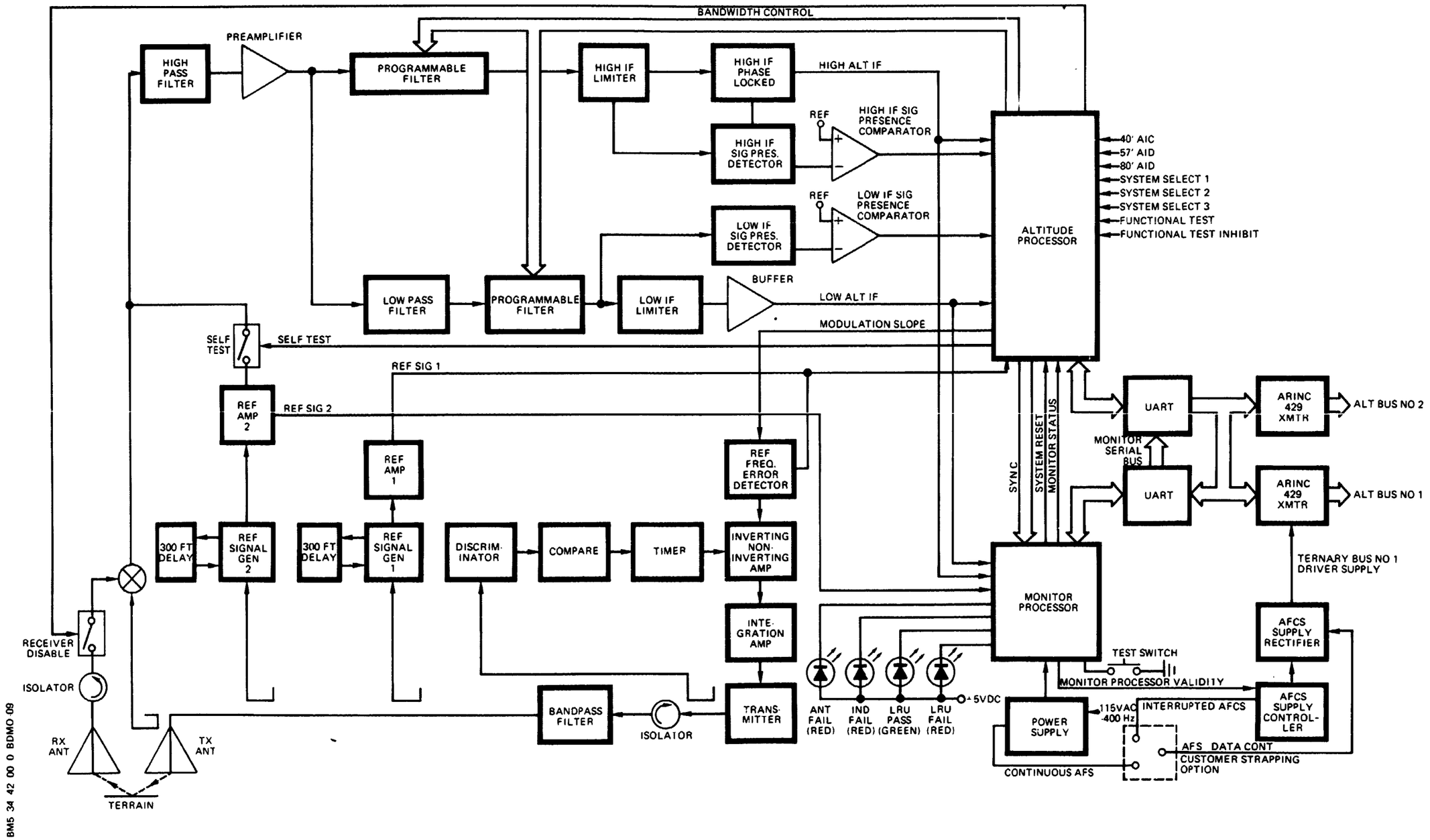
- two fasteners for securing the transceiver in its mount.
- a handle.

(b)The back features
a connector for connection of the transceiver to the aircraft electrical network.
(2)Principle of operation
(Ref. Fig. 004)
(a)Layout
The LRA-700 consists of a power supply, a modulator, an rf assembly, and an instrumentation assembly (processor) along with the necessary interconnect functions.
The LRA-700 is a radio altimeter using a wideband frequency modulated continuous wave (FM/CW) technique to measure the distance between the aircraft and the terrain below.
The function of the modulator is to provide the transmitter with a 100 Hz triangular wave corrected for transmitter nonlinearities, and also to maintain the transmitter deviation limits at 4250 MHz and 4350 MHz.
The modulator assembly also contains the high and low altitude if's,



BM5 34 42 00 0 BCMO 08

Transceiver Face
Figure 003



Functional Block Diagram
Figure 004

and two major closed loop circuits.
The first control loop controls the rate at which the transmitter's output frequency changes.
The other major control loop defines and contains the transmitted frequency within the 4250 to 4350 MHz normal band of operation.
The rf assembly contains all of the 4300 MHz functions. It is comprised of the transmitter stripline, receiver stripline and discriminator assemblies.
The instrumentation assembly consists of the altitude processor, the monitor processor and the power supply.

(b)Processing
The beat and reference frequencies from the if circuit board are converted to a binary number in the counter array and the microprocessor calculates the radio altitude based on the counter array data.
The altitude information is converted to Arinc 429 ternary data by being formatted and sent by the UART through the driver circuits to the autopilot and PFDs once every 30 or 40 milliseconds depending on aircraft altitude.

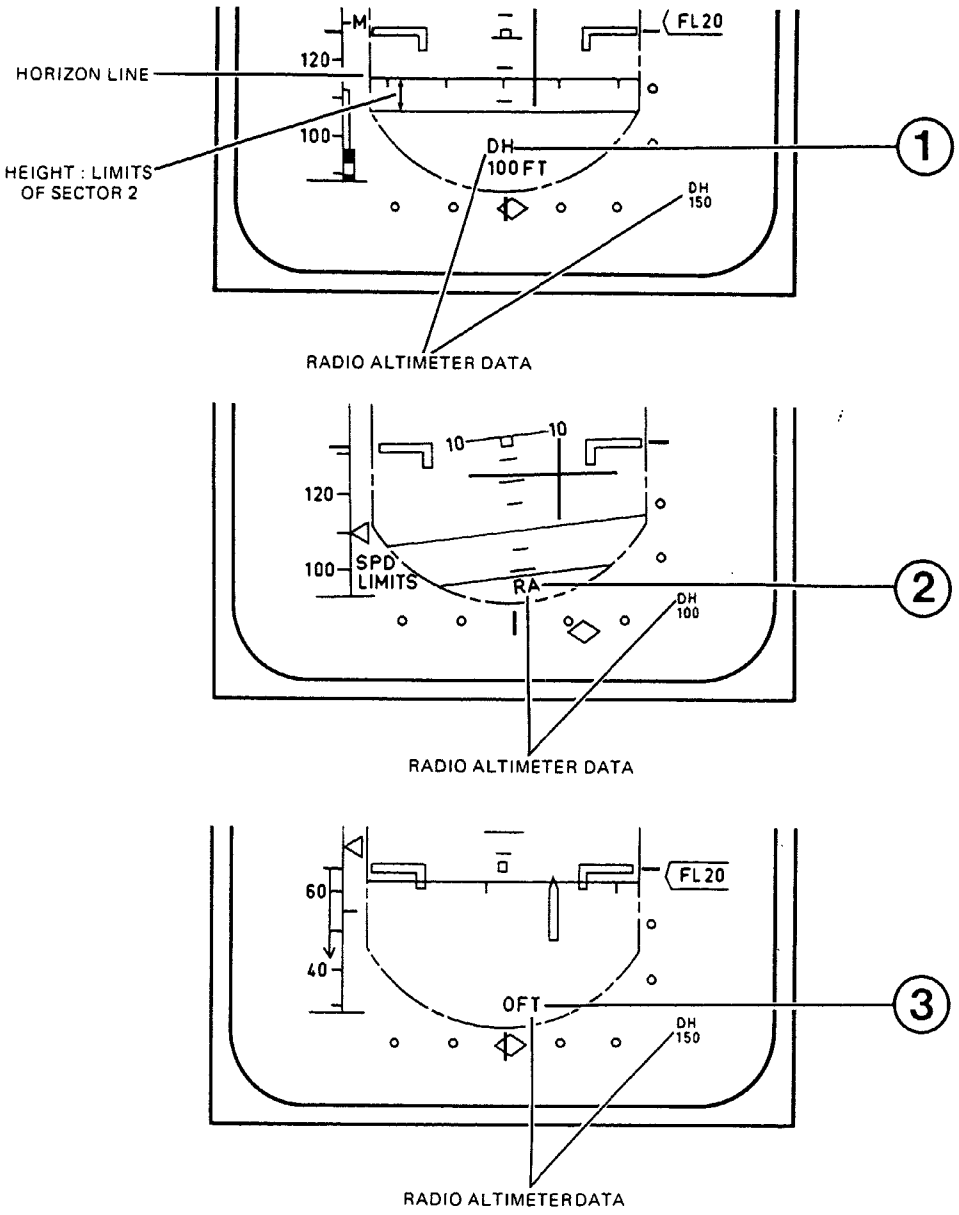
(c)Monitoring
The monitor processor counts and computes altitude, in the same manner as the altitude processor. Instead of transmitting ternary data, however, the monitor processor receives it and compares it with its own previously computed altitude. Any altitude disparity (outside of a fixed error window determined by software) generates a failure indication.
An incorrect word or altitude also causes the monitor processor to inhibit transmission of this data to the autopilot if the optional AFS interrupt mode is selected.
This is accomplished by disabling the AFS power supply during periods of incorrect data transmission and thereby shutting down the ALT bus No.1 ARINC 429 transmitter.

B. Radio Altimeter Displays

(1)Height data display on the PFD 34FN1 (34FN2)
(Ref. Fig. 005)
The aircraft height and decision height, with respect to the ground, are displayed in the PFD sector 2, for height less than or equal to 2500 ft.

(2)Decision height display on the EFIS Control Panel 42FN1 (42FN2)
(Ref. Fig. 006)
DH function is selected and read on the upper part of the EFIS Control Panel 42FN1 (42FN2).
The selection mode is shown in figure (Ref. Fig. 006)

C. Antennas 4SA1 (4SA2) and 5SA1 (5SA2)
(Ref. Fig. 007)
The transmission and reception antennas are identical.
Each antenna is in the form of a truncated pyramid.
The antenna is attached to a flat circular base which includes a locating pin and is installed flush with the aircraft structure. The



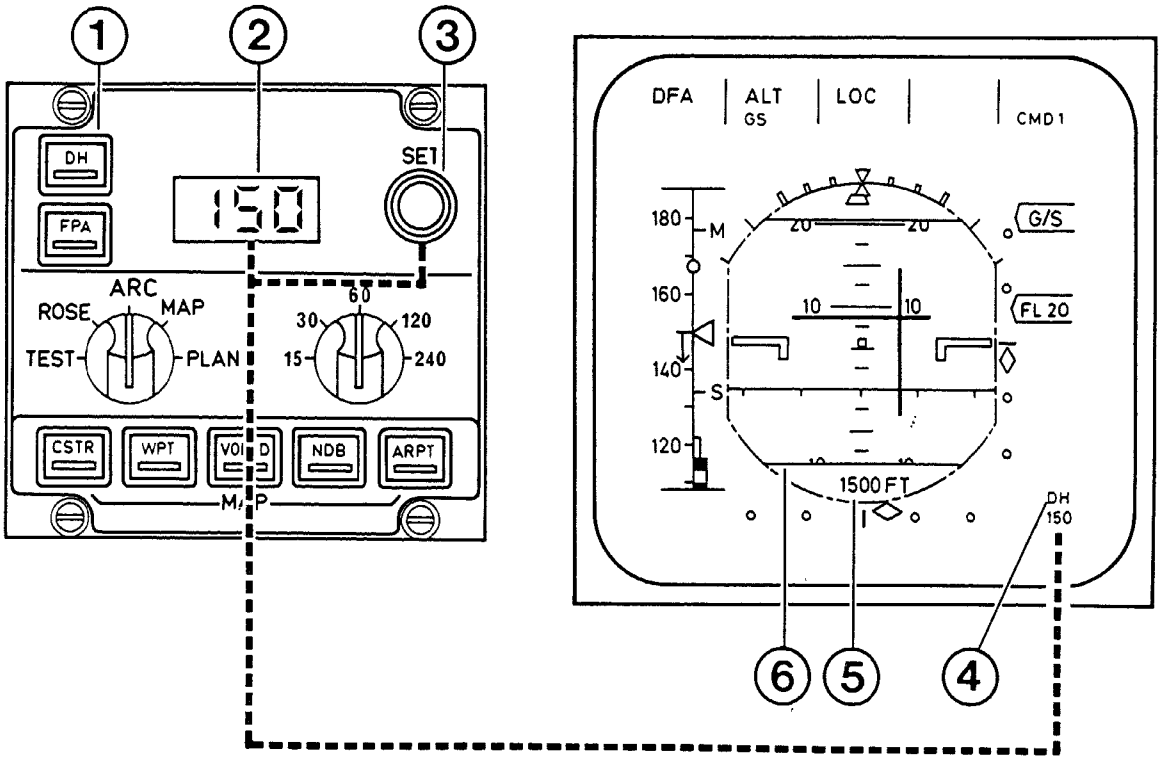
-1- DH ALERT MESSAGE :
THIS MAGENTA DH MESSAGE APPEARS WHEN THE RADIO HEIGHT IS LESS THAN THE DECISION HEIGHT.

-2- RADIO ALTIMETER FAILURE WARNING MESSAGE
THIS RED RA WARNING MESSAGE APPEARS WHEN BOTH RADIO ALTIMETER SYSTEMS HAVE FAILED

-3- RADIO HEIGHT - ROLL OUT INDICATION :
JUST AFTER TOUCH DOWN: RADIO HEIGHT IS 0 FT. AND THE MAGENTA DH ALERT MESSAGE DISAPPEARS FROM THE SPHERE.

BM5 34 42 00 0 BJMO 07

PFD - Radio Altimeter Displays
Figure 005



-1- DH PUSHBUTTON SWITCH :
WHEN IT IS PRESSED, THE LOWER STRIP ILLUMINATES GREEN AND THE DECISION HEIGHT IS DISPLAYED IN THE WINDOW USING SET KNOB.

-2- DISPLAY WINDOW :
DISPLAYS DECISION HEIGHT OR FPA, DEPENDING ON THE SELECTION, AND IS CONTROLLED BY THE SET KNOB.

-3- SET KNOB :
THIS DUAL KNOB ENABLES THE SETTING OF DECISION HEIGHT OR FPA ON THE DISPLAY WINDOW

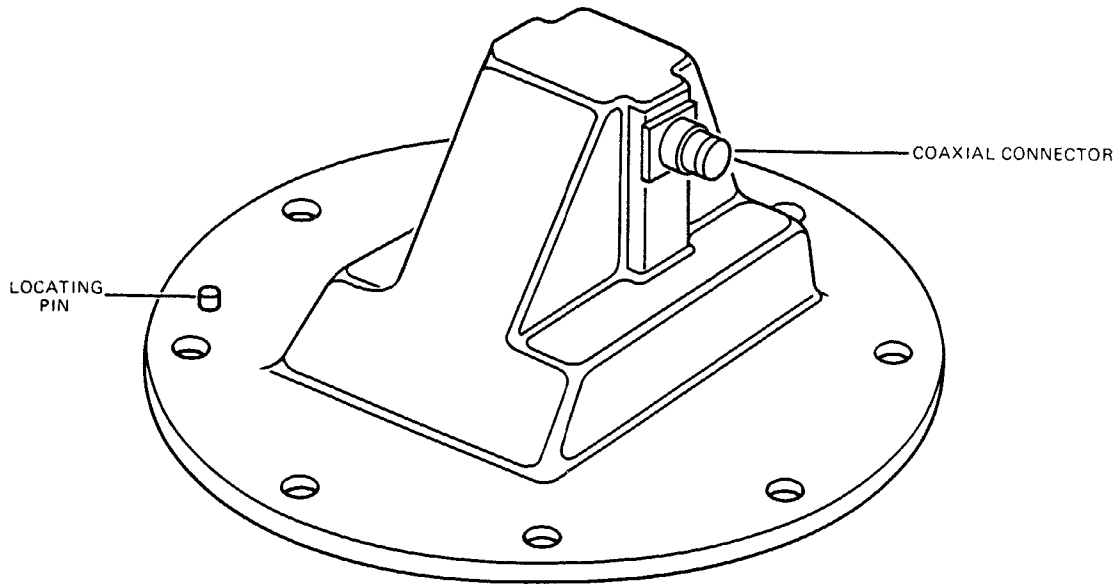
-4- DH ANNUNCIATOR :
THIS INDICATION IS CONTROLLED BY THE EFIS CONTROL PANEL. THE VALUE IS LIMITED TO 995 FEET

-5- RADIO HEIGHT INDICATION :
FOR ALTITUDES OF DH 100 FEET AND ABOVE, THE INDICATION IS GREEN, AND BELOW THIS VALUE, IT IS AMBER.

-6- RADIO HEIGHT SCALE :
JUST BEFORE TOUCH DOWN, THE PITCH SCALE IS ERASED ON THE LOWER SPHERE, AND A RADIO HEIGHT SCALE IS PRESENTED. THE DISTANCE BETWEEN TWO CONSECUTIVE GRADUATIONS DEPENDS ON THE RADIO HEIGHT.

BM5 34 42 00 0 BLMO 07

PFD - Approach before Glide Capture
Figure 006



Radio Altimeter - Antennas
Figure 007

antenna is supplied through a coaxial connector linked to the transceiver.

D. Fan 9 SA1 (9 SA2)
The six-blade fan is integral with a removable base plate attached under the transceiver mount. It is contained in a square aluminum alloy case. It is supplied with 115VAC through a connector and associated wiring connecting it to the transceiver. Parasites are suppressed by a capacitor mounted on the fan case.

5. Overall System Operation
(Ref. Fig. 008)

A. Transceivers Power Supply
(Ref. Fig. 009)
Both systems are supplied as soon as NORMAL 115V 400Hz buses are powered.
(1)Radio altimeter transceiver 1 1SA1.
The transceiver 1 is supplied from ESS Bus 301 XP through circuit breaker 7SA1 located on panel 21VU.
(2)Radio altimeter transceiver 2 1SA2
The transceiver 2 is supplied from Normal Bus 205XP through circuit breaker 7SA2 located on panel 21VU.
The power consumption of each transceiver is 28W.

B. Data Display
(1)Height data
The aircraft height with respect to the ground is displayed in the PFD sector 2, for heights less than or equal to 2500 ft.
The dimensions and color of digits vary as a function of height and decision height, as follows :
- H ≥ 1000 : 4 mm (0.156 in.) green digits.
- H < 1000 : 5 mm (0.195 in.) green digits.
(only if DH + 100 < 1000)
- H < DH + 100 : 5 mm (0.195 in.) amber digits.
The sensitivity of the display is also a function of height :
- H > 50 ft. : 10 ft. increments.
- 5 ≤ H ≤ 50 ft. : 5 ft. increments.
- H < 5 ft. : 1 ft. increments.
In case of failure of the radio altimeter being used, switching to the other instruments is automatically performed. The failed system is indicated on the left ECAM display unit.
In case of failure of both radio altimeters, the digits disappear and are replaced by a Red RA failure warning message (5 mm (0.195 in.) red digits) which flashes during three seconds, then remains on.
The RA message is displayed in slats extended configuration only (the bit 1 (1) of the word 274 in FAC is set to zero).
(2)Decision Height (DH) data
It is displayed in the RH lower corner of the PFD (3 mm (0.117 in.) high dark blue digits), as soon as the radio altimeter is in operation (that is when H ≤ 2500 ft.). When the height is lower than the decision height, an amber DH alert message (6 mm (0.234 in.)) is

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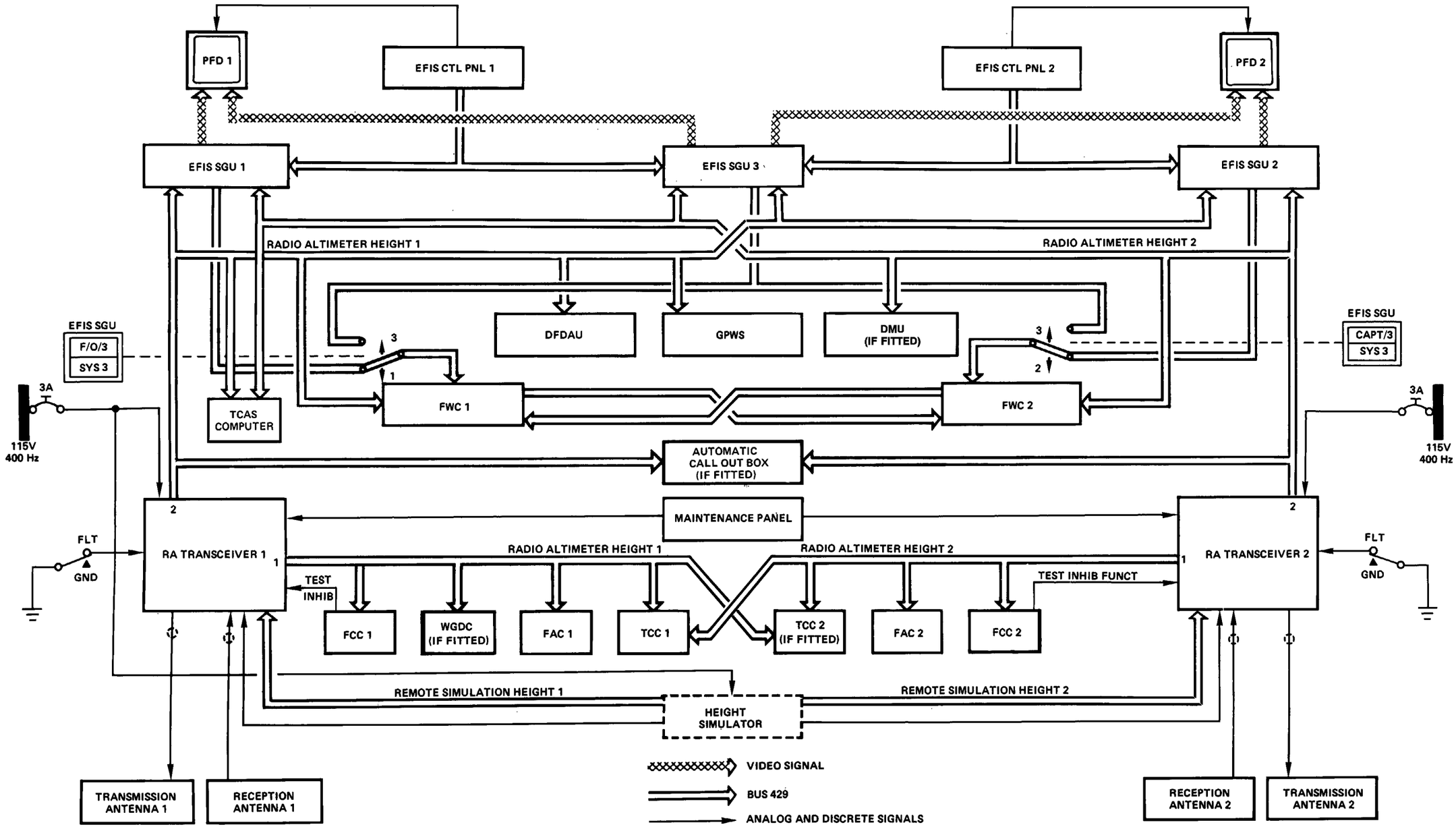
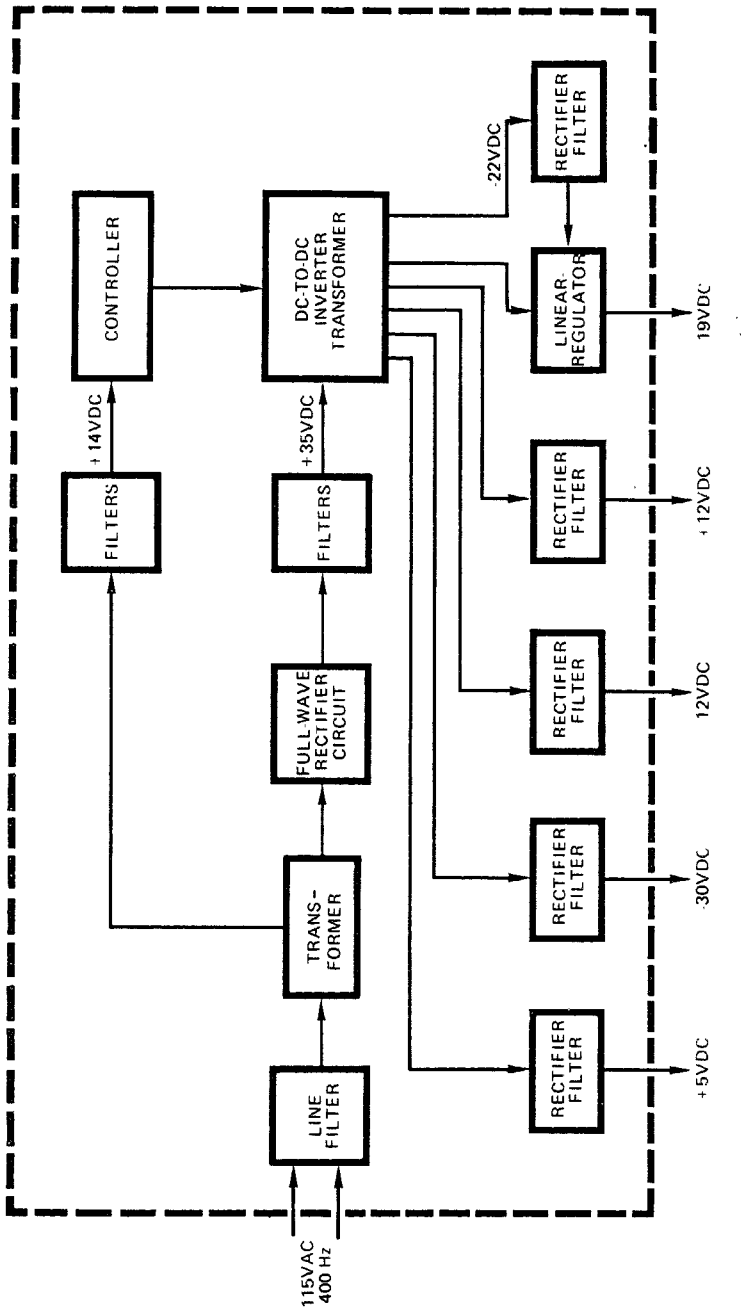


BM5 34 42 00 0 AMB0 01

Radio Altimeter System - Functional Interconnection
Figure 008

R



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Radio Altimeter System - Power Supply
Figure 009

displayed above sector 2. (This indication must be inhibited at take-off). In case of failure, DH data is not displayed; it is replaced by a red DH failure warning message which flashes during 3 seconds, then remains on in the RH lower corner of the PFD.

(3)Approach

Below 300 ft., on the PFD, the height is represented by the distance between the horizon line and the limit of sector 2 which moves upwards, in relation to, and just below the horizon line (sensitivity : 1 mm for 10 ft.). As it moves upwards, the limit of sector 2 masks the graduations on the lower sphere.

In case of failure of the radio altimeter, this data disappears.

C. Radio Altimeter Test

On CAPT and F/O EFIS control panels select a decision height of 040 feet.
DH alert message and same DH value are displayed on CAPT and F/O PFDs.
On flight compartment maintenance panel press and hold (10 seconds) RAD ALT 1 (RAD ALT 2) pushbutton switch. On CAPT PFD (F/O PFD) the test value 40 ± 5 ft. is displayed until switch is released.
Release RAD ALT 1 (RAD ALT 2) pushbutton switch, the RA test value drops to "0 Foot" and the DH alert message is displayed again.
On CAPT and F/O EFIS control panels release DH pushbutton switch.

6. Operation

A. Theory of Operation

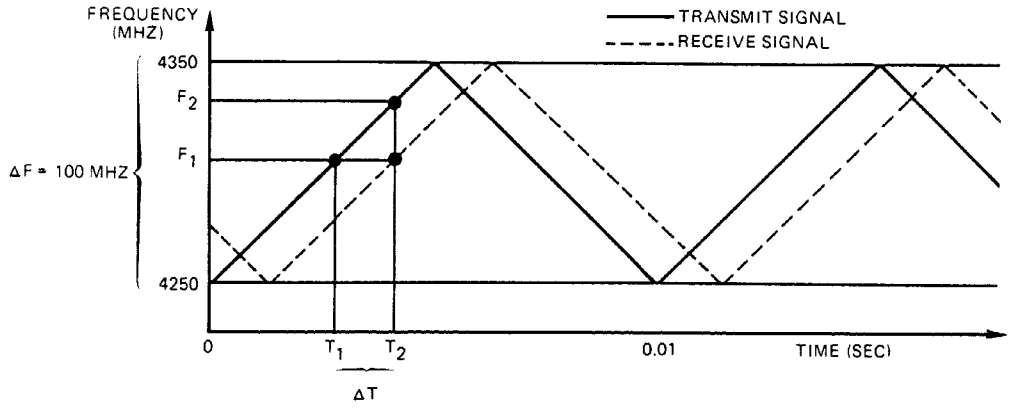
(Ref. Fig. 004)
(Ref. Fig. 010)

The height of the aircraft is calculated by determining the difference between the frequency of the reflected signal and the signal being transmitted at the instant the reflected signal is received. This difference frequency is directly proportional to the time required for the reflected signal to traverse the distance from the aircraft to the ground and back to the aircraft. The difference frequency is measured and converted to distance by a microprocessor in the altitude processor which also transmits the measured distance to user equipment over the ARINC 429 bus.

The reflected signal is fed from a dedicated receive antenna to the receiver where it is mixed with a portion of the transmitted signal now being radiated at the transmit antenna to develop a beat frequency (Fb). The beat frequency is processed by the if system and is sent to the altitude and monitor processors.

Two independant samples of transmitted rf are fed to two reference signal generators. Each generator produces an output (Fr) corresponding to the delay time that represents a 300-foot altitude-Fr1 is the reference signal for the altitude processor, FR2 is the reference signal for the monitor processor.

The altitude processor samples the beat frequency input signal (Fb) and the reference beat frequency signal (Fr1) and converts each to digital form. The ratio of the measured frequency input signal (Fb) to the output of the 300-foot reference channel is calculated and multiplied by 300 to produce the total radio altitude. The total radio altitude is further modified by



BM5 34 42 00 0 BQMO-07

Radio Altimeter - Principle of Operation
Figure 010

AID and internal box delays to produce the actual aircraft altitude above terrain.

B. Radio Altimeter Bite Test
On radio altimeter transceiver face press and hold (10 seconds) TEST pushbutton switch.
All four LEDs should come on for approximately 3 seconds to verify their operation and then go off. Three seconds after both LEDs are off, the green LRU-STATUS-PASS LED should come on indicating the unit checks good.

7. Interface
The radio altimeter provides information to the following systems :
- AFS (Auto Flight System) which essentially consists of FAC, TCC and FCC.
The MTP (Maintenance Test Panel) only receives failure signals from radio altimeter through the FCC.
- DFDAU (Digital Flight Data Acquisition Unit)
R - TCAS computer (Traffic Collision Avoidance System)
- GPWC (Ground Proximity Warning Computer)
- FWC (Flight Warning Computer)
- SGU (Symbol Generator Unit)
- PFD (Primary Flight Display)

1. Operational Test

A. Reason for the Job
BITE test

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-71-00, P. Block 501	EFIS (INPUTS Test)

C. Procedure
NOTE : The aircraft must be in an area free of all obstacles (personnel, ladders, vehicles, etc) within a minimum distance of 5 meters from the antennas.

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(1)Job set-up
- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION, MIN EQPT BAY SUPPLY/NAVIGATION and ECAM.
- Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (aircraft in ground configuration).
- Make certain that slats are extended (necessary for RA warning message display) (System test only).
- Make certain that EFIS/SGU SWITCHING are in normal position (on 402VU & 406VU).
- On overhead panel, place MSU 1 and 2 mode selector switch in NAV
R position and wait until the sphere is displayed on CAPT and F/O PFDs.
- Make certain that EFIS is operating and adjust PFD and ND images brightness on panels 412VU and 413VU.
- On ECAM control panel, press CLR pushbutton switch until MASTER WARN and MASTER CAUTION lights go off and MEMO page is displayed on L ECAM display unit.

(a)On overhead panel, open the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/RAD ALTM 1	7SA1	107/C5
21VU	RADIO-NAV & COM/RAD ALTM 2	7SA2	107/C10
21VU	NAVIGATION/GPWS/CMPTR	6WZ	108/B11

(2)Test

NOTE 1 : To carry out this test, the AP/FD must not be engaged in LAND Mode.

NOTE 2 : Information in parentheses concerns system 2 test, which is identical to system 1 test.

ACTION	RESULT
1. On panel 21VU, close circuit breaker 7SA1 (7SA2)	Under transceiver case, check that cooling fan blows upwards (zone 152, access door 812)
2. On maintenance panel 47OVU - press and hold EFIS/INPUTS push-button switch (Ref. 34-71-00, P. Block 501) - release EFIS/INPUTS pushbutton switch	On CAPT and F/O PFD, check that : - the messages concerning LRRA 1 (LRRA 2) inputs test of EFIS SGU 1 and EFIS SGU 2 are not displayed
3. On CAPT and F/O EFIS control panels - press DH pushbutton switches	On CAPT and F/O EFIS control panels check that : - power lights (lower strips) come on green
- select decision height of 20 ft. by means of SET knobs	- display windows indicate 20 ft. On CAPT and F/O PFD, check that : - DH and 20 ft. are displayed in R lower corner - DH alert message remains displayed on the lower part of the sphere.
4. On maintenance panel 47OVU - press and hold RAD ALTM 1 (RAD ALTM 2) pushbutton switch	On CAPT and F/O PFD check that : - limit of sector 2 moves downwards with respect to horizon line - radio height is 40 ±5 ft. - DH alert message disappears R - "Forty" announcement is heard.
- release RAD ALTM 1 (RAD ALTM 2) pushbutton switch	- limit of sector 2 moves upwards to horizon line - radio height is approximately 0 ft. - DH alert message reappears
5. On panel 21VU, open circuit breakers 7SA1 (7SA2).	On CAPT and F/O PFD check that : - radio height disappears on the lower part of the sphere and is replaced by a red RA failure warning message which flashes for three seconds then remains on. - DH alert message disappears - DH and 20 ft. are no longer displayed in R lower corner. - graduations appear in the sector 2

ACTION	RESULT
	- limit of sector 2 moves downwards and stops above red RA message. On CAPT and F/O main instrument panels 3VU and 5VU - MASTER CAUTION lights come on. - Single chime sounds - Message : NAV ADC RA 1 + 2 FAULT is displayed on L ECAM display unit.
6. On panel 21VU, close circuit breakers 7SA1 and 7SA2	All the instruments come back to normal operation.
7. On maintenance panel 47OVU - press and hold EFIS/INPUTS push-button switch (Ref. 34-71-00, P. Block 501) - release EFIS/INPUTS pushbutton switch	On CAPT and F/O PFD, check that : - the messages concerning LRRA 1 and LRRA 2 input test of EFIS SGU 1 and EFIS SGU 2 are not displayed.

(3)Close-up
(a)On overhead panel, on MSU1 and 2, place mode selector switch in OFF position.
(b)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(c)Restore system and aircraft to normal operating condition.

2. Functional Test
Identical to operational test.

3. System Test

A. Reason for the Job
- Check of automatic simulation variation
- Check of DH indications
- Check of RA indication switching from EFIS SGU3
- Check of RA warnings and reconfiguration.

B. Equipment and Materials

ITEM	DESIGNATION
(1)9599-607-15902	Simulator-Radio Altimeter, TRT SIM 530

ITEM	DESIGNATION

R **ON A/C 101-200,

R (2)99A34301101400 Adaptor Box - Test Set,
R Radio Altimeter TRT SIM 530

R **ON A/C ALL

Referenced Procedures
- 24-41-00, P. Block 301 AC External Power Control
- 27-81-00, P. Block 501 Mechanical and Electrical Controls (Slats)
- 34-71-00, P. Block 501 EFIS/INPUTS Test

C. Procedure

NOTE : The aircraft must be in an area free of all obstacles (personnel, ladders, vehicles, etc) within a minimum distance of 5 meters from the antennas.

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(1)Job set-up
- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION, MIN EQPT BAY SUPPLY/NAVIGATION and ECAM.
- Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (aircraft in ground configuration).
- Make certain that slats are extented (necessary for RA warning message display).
- On center pedestal, adjust ECAM display unit brightness.
- On ECAM control panel, make certain that legends of ECAM SGU1 and 2 pushbutton switches are off.

R **ON A/C 001-100,

- On L and R instrument panels 402VU and 406VU, make certain that EFIS/SGU, PFD/ND XFR pushbutton switches are in normal position (released).

R **ON A/C 101-200,

- On L and R instrument panels 402VU and 406VU, make certain that EFIS/SGU pushbutton switches are in normal position (released).

R **ON A/C ALL

- On overhead panel, place MSU1, 2 and 3 mode selector switch in NAV position and wait until the attitude data are displayed on CAPT and F/O PFDs.

- On CAPT and F/O complementary navigation control panels 413VU and 412VU, adjust brightness on both PFDs and NDs.

R **ON A/C 001-100,

(a)On panel 131VU
- connect harness W89 to 1275VC and to test connector on radio altimeter simulator.

R **ON A/C 101-200,

R (a)On F/O console 131VU
R - connect TRT/COLLINS adaptor to RAD ALT TEST connector 1275VC and to
R harness W89.
R - connect this one to radio altimeter SIM530.

R **ON A/C ALL

(b)On radio altimeter simulator
- turn ± potentiometer to-stop
- place D/A OUTPUT switch to SIM position
- place RA DISPLAY SELECT switch in position 1 for radio altimeter system 1 (position 2 for radio altimeter system 2)
- in REMOTE TEST ALTITUDE windows select :
  2500 for UPPER
  42 for SLOPE
  + 0 for LOWER
- in automatic simulation select the continuous symmetrical cycle (2 symmetrical pulses) by means of the two L selector switches
- place ON/OFF switch in ON position.

(c)When energized
- radio altimeter indications are displayed on CAPTAIN and F/O PFDs
- radio altimeter system 1 and 2 cooling fans operate (they are located in the aft cargo compartment on a shelf forward of the compartment door for radio altimeter system 1 and aft of the compartment door for radio altimeter system 2).

(2)Test

NOTE 1 : To carry out this test, AP/FD must not be in LAND Mode.
NOTE 2 : Information in parentheses concerns system 2 test, which is identical to system 1 test.
NOTE 3 : In order to check the MINIMUM sound, on SIM 530 (REMOTE TEST ALTITUDE SLOPE window) reduce the slope indication from 42 to 10 when RA height in descent phase reaches 500 ft. on CAPT and F/O radio altimeter indicators and PFDs.

(a)Check of automatic simulation of altitude variation

ACTION	RESULT
1. On CAPT and F/O EFIS control panels - press DH pushbutton switches	Check that : - power lights (lower strips) come on - display windows indicate 0ft.

ACTION	RESULT
- select decision height of 200ft. (CAPT side) and 100ft. (F/O side) by means of SET knob	Check that : - display windows indicate 200ft. and 100ft. On CAPT and F/O PFDs, check that : - DH and 200ft. ; DH and 100ft. are displayed respectively in R lower corner.
2. On radio altimeter simulator - press START SIM pushbutton switch briefly	On CAPT and F/O PFDs - altitude indication starts at 0, increases to 2500 ±50 ft. in approx. 1 mn, then decreases to 0 in the same lapse of time and the cycle continues.
3. In decreasing altitude	When altitude reaches 215 ft. (DH CAPT + 15 ft.), the MINIMUM announcement sounds until altitude reaches 200 ft. Check that : - in lower part of CAPT PFD, DH alert message appears - on CAPT and F/O PFDs, when altitude reaches 150 ft., the white line moves upwards to the horizon line and masks graduations on the pitch scale. When altitude reaches 115 ft. (DH F/O + 15 ft.) the MINIMUM announcement sounds until altitude reaches 100 ft. Check that : - in lower part of F/O PFD, DH alert message appears.
4. In increasing altitude	On CAPT and F/O PFDs check that : - between 0 and 150 ft., the white line moves downwards showing the graduations on the pitch scale. On F/O PFD, check that : - DH alert message disappears when altitude reaches 100 ft. On CAPT PFD, check that : - DH alert message disappears when altitude reaches 200 ft.
On radio altimeter simulator - press RA1 HOLD pushbutton switch	On CAPT PFD, check that : - altitude indication does not

ACTION	RESULT
	vary On F/O PFD, R - altitude indication does not R vary
- release RA1 HOLD pushbutton switch	On CAPT PFD, check that : - the value displayed returns to the value displayed on F/O PFD.
5. When the altitude displayed on both PFDs is 0, place mode selector switch in OFF position and ON/OFF switch in OFF position on simulator.	

(b)Check of DH indications

ACTION	RESULT
1. On CAPT (F/O) EFIS control panel - press DH pushbutton switch	Check that : - power light (lower strip) comes on - display indicates 0 ft.
- select decision height of 20 ft. by means of SET knob	Check that : - display indicates 20 ft. On CAPT (F/O) PFD, check that : - DH and 20 ft. are displayed in R lower corner - DH alert message appears in the lower part of the sphere.
2. On maintenance panel 47OVU - press and hold RAD ALTM 1 (RAD ALTM 2) pushbutton switch - release RAD ALTM 1 (RAD ALTM 2) pushbutton switch	On CAPT (F/O) PFD, check that : - DH alert message disappears - radio height is 40 ±5 ft. - DH alert message appears - radio height is approx. 0 ft.
3. On CAPT (F/O) EFIS control panel - release DH pushbutton switch or select FPA pushbutton switch	Check that : - power light (lower strip) goes off
- press DH pushbutton switch.	On CAPT (F/O) PFD, check that : - decision height displayed by means of SET knob is still recopied.
4. On panel 21VU open circuit breaker 43FN1 (43FN2)	On CAPT (F/O) PFD, check that : - DH indications are replaced by a red DH failure warning message which flashes during 3 s then

ACTION	RESULT
	remains on in the R lower corner.
5. On panel 21VU close circuit breaker 43FN1 (43FN2)	On CAPT (F/O) PFD, check that : - red DH failure warning message disappears.
6. On CAPT (F/O) EFIS control panel - release DH pushbutton switch	Check that : - power light (lower strip) goes off On CAPT (F/O) PFD, check that : - DH and 20 ft. remain displayed.

(c)check of RA indication switching from EFIS SGU3

ACTION	RESULT
1. On panel 21VU open circuit breakers 30FN1 and 30FN2	On CAPT and F/O PFDs, check that : - any indications are displayed.
2. On instrument panel 402VU - press EFIS SGU pushbutton switch	On EFIS SGU pushbutton switch, check that : - SYS 3 legend comes on On R instrument panel 406VU, EFIS SGU pushbutton switch - CAPT/3 legend comes on On CAPT PFD - radio altimeter indications are displayed.
3. On L instrument panel 402VU - press to release EFIS SGU pushbutton switch	On EFIS SGU pushbutton switch, check that : - SYS 3 legend goes off On R instrument panel 406VU, EFIS SGU pushbutton switch - CAPT/3 legend goes off On CAPT PFD - radio altimeter indications disappear.
4. On R instrument panel 406VU - press EFIS SGU pushbutton switch	On EFIS SGU pushbutton switch, check that : - SYS 3 legend comes on On L instrument panel 402VU, EFIS SGU pushbutton switch - F/O/3 legend comes on On F/O PFD - radio altimeter indications are displayed.
5. On R instrument panel 406VU	On EFIS SGU pushbutton

ACTION	RESULT
- press and release EFIS SGU push-button switch	switch, check that : - SYS 3 legend goes off On L instrument panel 402VU, EFIS SGU pushbutton switch - F/O/3 legend goes off On F/O PFD - radio altimeter indications disappear.
6. On panel 21VU close circuit breakers 30FN1 and 30FN2	On CAPT and F/O PFDs, check that : - radio altimeter indications are displayed.

(d)Check of RA warnings and reconfiguration

ACTION	RESULT
1. On center pedestal - move slat/flap control lever to position 2 (Ref. 27-81-00, P. Block 501)	- Slats extend to 15° position.
2. On panel 21VU open circuit breaker 7SA1 (7SA2)	On CAPT and F/O main instrument panels 3VU and 5VU - MASTER CAUTION lights come on. - Single chime sounds - Message NAV ADC RA1 FAULT (RA2 FAULT) is displayed on L ECAM display unit.
3. On panel 21VU, close circuit breaker 7SA1 (7SA2) then open circuit breakers 7SA1 and 7SA2	On CAPT and F/O main instrument panels 3VU and 5VU - MASTER CAUTION lights come on. - Single chime sounds - Message NAV ADC RA1 + RA2 FAULT is displayed on L ECAM display unit.
4. On panel 21VU, close circuit breaker 7SA1, then 7SA2	On CAPT and F/O PFDs check that : - red RA failure warning disappears On left ECAM DU check that : - NAV ADC RA1 + 2 FAULT message disappears.
5. On center pedestal	Slats retract to clean

ACTION	RESULT
- move slat/flap lever to position 1 (Ref. 27-81-00, P. Block 501)	configuration.
6. On maintenance panel 47OVU - press EFIS/INPUTS pushbutton switch (Ref. 34-71-00, P. Block 501)	On CAPT and F/O PFDs check that : - messages concerning LRRA1 and LRRA2 input test of EFIS SGU1 and EFIS SGU2 are not displayed.
- release EFIS/INPUTS pushbutton switch.	

(3)Close-up
(a)On overhead panel, on MSU 1, 2 and 3, place mode selector switch in OFF position.
(b)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(c)Restore system and aircraft to normal operating conditions.

**ON A/C 101-200,

(d)Remove TRT/COLLINS adaptator.

RADIO ALTIMETER TRANSMISSION AND RECEPTION ANTENNA (4SA1, 4SA2, 5SA1,5SA2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.7 m (9.03 ft.)
B.	Circuit Breaker Safety Clips
C.	Blanking Caps
D.	Milliohmeter
E.	Resistant - corrosion steel lockwire 0.5 mm (0.02 in.) diameter
F.	Scraper - Non Metallic
G. Material No. 05-013	Special Materials (Ref. 20-31-00)
H. Material No. 08-001	Bonding and Adhesive Compound (Ref. 20-31-00)
I. Material No. 09-001	Sealants (Ref. 20-31-00)
J. Material No. 09-001D	Sealants (Ref. 20-31-00)
K. Material No. 09-016	Sealants (Ref. 20-31-00)
or Material No. 09-008E	Sealants (Ref. 20-31-00)
L. Material No. 09-019	Sealants (Ref. 20-31-00)
M. Material No. 12-005	Strippers (Ref. 20-31-00)
N. Material No. 16-001	Structure Paints (Ref. 20-31-00)
O. Material No. 16-018	Structure Paints (Ref. 20-31-00)
P. Material No. 16-021	Structure Paints (Ref. 20-31-00)
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

2. Procedure

R **ON A/C 001-100,

R Post SB 24-2096 For A/C 001-100,

R 1. Equipment and Materials

R ITEM	DESIGNATION
R A.	Access Platform 2.7 m (9.03 ft.)
R B.	Circuit Breaker Safety Clips
R C.	Blanking Caps
R D.	Milliohmeter
R E.	Scraper - Non Metallic
R F. Material No. 05-013	Special Materials (Ref. 20-31-00)
R G. Material No. 07-001D	Lacquers (Ref. 20-31-00)
R H. Material No. 07-020	Lacquers (Ref. 20-31-00)
R I. Material No. 08-001	Bonding and Adhesive Compound (Ref. 20-31-00)
R J. Material No. 08-048	Bonding and Adhesive Compound (Ref. 20-31-00)
R K. Material No. 09-001	Sealants (Ref. 20-31-00)

ITEM	DESIGNATION
L. Material No. 09-001D	Sealants (Ref. 20-31-00)
M. Material No. 09-016	Sealants (Ref. 20-31-00)
or	
Material No. 09-008E	Sealants (Ref. 20-31-00)
N. Material No. 09-019	Sealants (Ref. 20-31-00)
O. Material No. 12-005	Strippers (Ref. 20-31-00)
P. Material No. 16-001	Structure Paints (Ref. 20-31-00)
Q. Material No. 16-018	Structure Paints (Ref. 20-31-00)
R. Material No. 16-021	Structure Paints (Ref. 20-31-00)
Referenced Procedure	
- 24-41-00, P. Block 301	AC External Power Control

2. Procedure

**ON A/C 001-100,

(Ref. Fig. 401)

**ON A/C 001-100,

Post SB 24-2096 For A/C 001-100,

(Ref. Fig. 402)

**ON A/C 001-100,

NOTE : The removal/installation operations for antennas 4SA1, 4SA2, 5SA1 and 5SA2 are identical. Only the operations concerning transmission antenna 4SA1 are described.

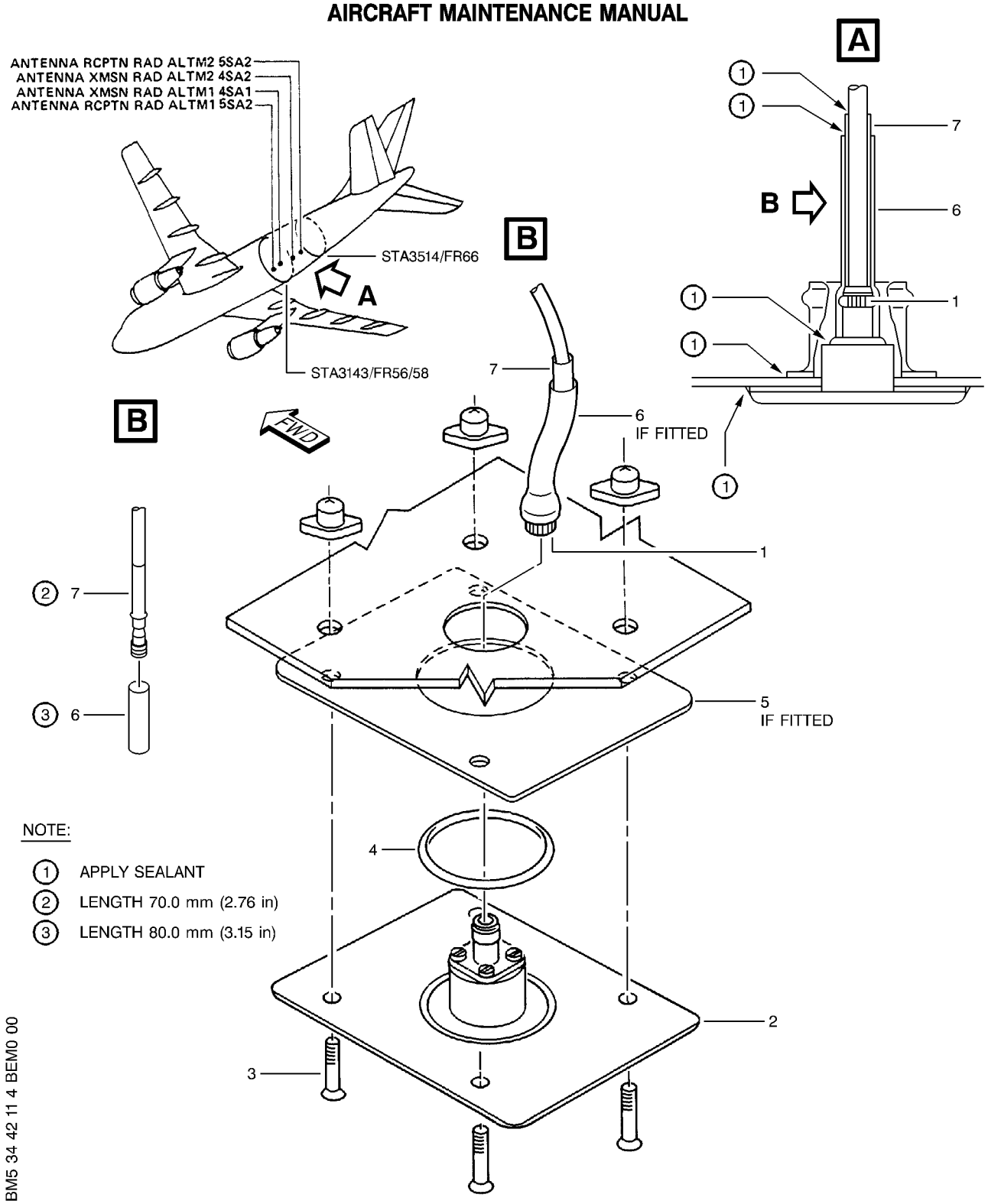
A. Job Set-Up
(1)Position access platform.
(2)Open, safety and tag the following circuit breakers :
(a)For antennas 4SA1 and 5SA1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO - NAV & COM/RAD ALTM 1	7SA1	107/C 5

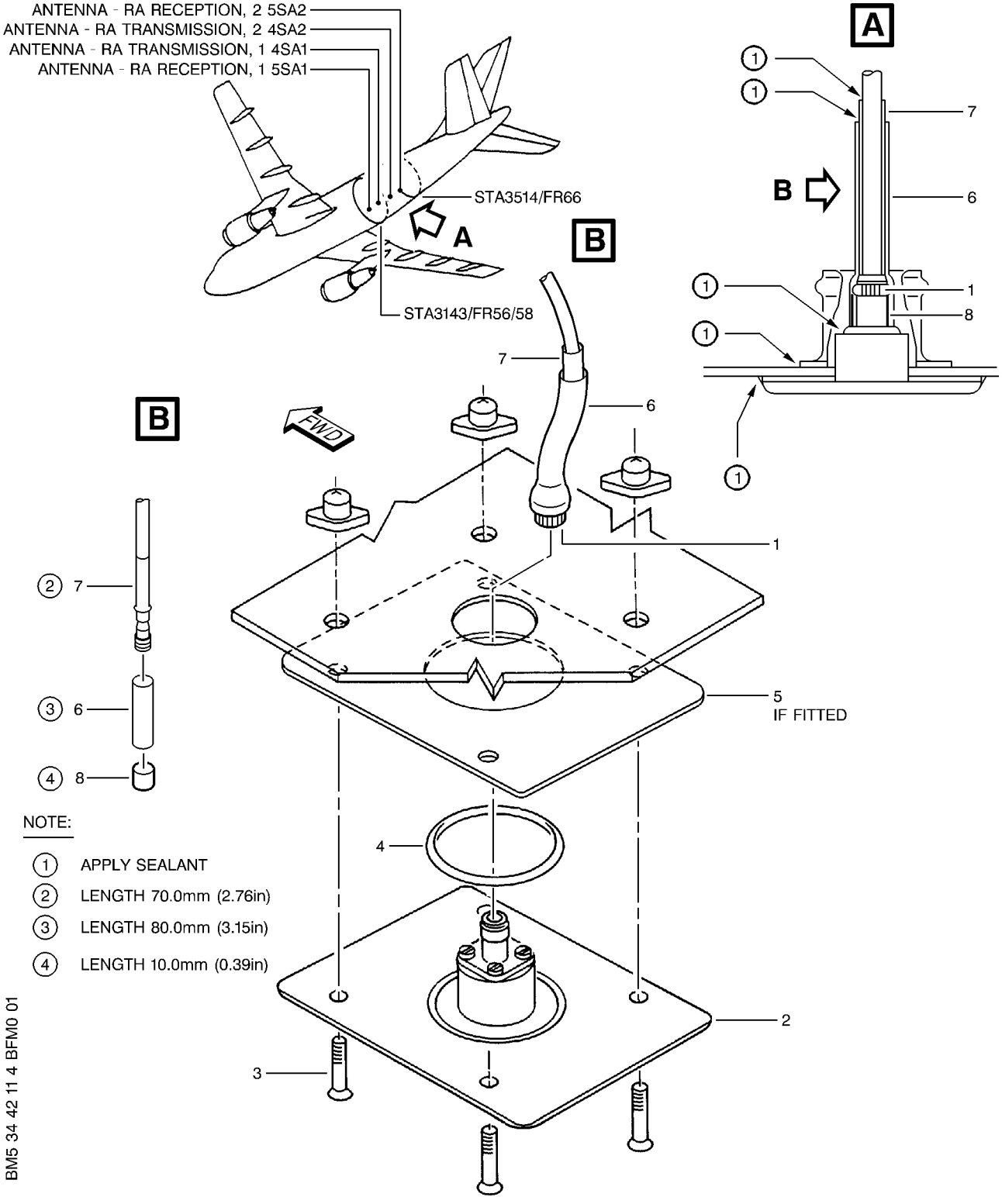
(b)For antennas 4SA2 and 5SA2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO - NAV & COM/RAD ALTM 2	7SA2	107/C10

B. Removal
(1)Remove the four antenna (2) attachment screws (3).



Radio Altimeter Transmission and Reception Antenna
Figure 401



Radio Altimeter Transmission and Reception Antenna
Figure 402

R

(2)Withdraw antenna (2) until coaxial connector (1) is visible and accessible.
(3)If installed, remove sealant from shrink sleeve (6) with a non-metallic scraper.
(4)Carefully remove shrink sleeve (6) from coaxial connector (1).
(5)Disconnect coaxial connector (1) from antenna (2).
(6)Remove and clean seal (5). After inspection, discard seal if damaged.
(7)Blank coaxial connector (1) and antenna (2) receptacle.
(8)Clean areas of contact between fuselage and antenna (2).

C. Preparation
- On the Radio Altimeter antenna :
(1)The replacement antenna must not show any evidence of corrosion or of protective compound. These must not be any defect.
(2)If a first visual check of the radio altimeter antenna reveals corrosion then proceed as follows :
(a)Remove any remains of sealing material.
Check antenna for corrosion.
(b)Apply stripper (Material No. 12-005) on corrosion spots of antenna mating flange.
NOTE 1 : If the visual inspection of the antennas reveals either :
- scratches on the radiating surface (circle shaped) or,
- corroded or damaged connectors or,
- red marks (mounting direction) no longer visible or,
- paint on radiating surface partly, or fully flaked off,
the antenna should be replaced.
NOTE 2 : The application of paint of any type on the outer radiating surface is prohibited.
(c)Clean antenna countersunk holes.
- On the aircraft fuselage (antenna area) :
(1)If a first visual check of the fuselage (antenna area) reveals corrosion, then proceed as follows :
(a)Remove any remains of sealing material.
(b)Mechanically rework corrosion spots (max. grinding depth 1 mm (0.04 in.)).
(c)Rework damaged surface with Alradite (Material No. 08-001).
(d)Polish surface.
(e)Spray fuselage areas with structure paints (Materials No. 16-001 and 16-018).
(f)Paint antenna contact surfaces on fuselage with special materials (Material No. 05-013).
(g)Mask mounting holes against sealing material.
(h)Prepare contact surface on fuselage side with approximately 1 mm (0.04 in.) or even depth of sealants (Material No. 09-019).
NOTE : The sealing material has to be sufficiently fluid to fill up only gap between antenna flange and aircraft mounting support due to wavy surfaces. Rest sealing thickness has to be as small as possible.

D. Installation
(1)Remove blanking cap from coaxial connector (1) and from antenna (2)

receptacle.
(2)Make certain that O-ring (4) is correctly installed.
(3)Install seal (5) between fuselage and antenna (2).
(4)Position antenna (2).
(5)If installed, push shrink sleeve (6) over coaxial cable.
(6)Connect coaxial connector (1) to antenna (2). TORQUE the coaxial connector (1) to 0.265 m.daN (23.44 lbf.in.) and safety it with corrosion-resistant steel lockwire 0.5 mm (0.02 in.) diameter.
(7)If installed, shrink sleeve (6) over both parts of connector (1).
(8)Apply sealants (Material No. 09-001 or 09-001D) over the ends of the shrink sleeve (6) and also on antenna body (inner part up to the O-ring (4)).
(9)TORQUE the three countersunk screws (3) to between 0.3 and 0.35 m.daN (26.54 and 30.97 lbf.in.) so that antenna is secured inside of fuselage skin contour.
(10)Remove sealing material that has been squeezed out during this operation.
NOTE : Only an extremely thin film of sealing material should now be left between the antenna flange and the fuselage.
(11)Using a milliohmeter, apply one probe on the inner metallic area of the remaining antenna hole, and the other one on the A/C fuselage.
(12)Check that the bonding resistance does not exceed 5 milliohms.
(13)TORQUE the last screw to between 0.3 and 0.35 m.daN (26.54 and 30.97 lbf.in.) to complete the antenna attachment.
Remove sealing material that has been squeezed out during this operation.
(14)Apply a sealing bead of sealants (Material No. 09-016 or 09-008E) around antenna (2).
(15)Apply a sealant on the screw heads to protect them.
(16)Apply a bead of sealants (Material No. 09-016 or 09-008E) around the mating flanges.
After sealant bead has fully dried, apply a protective coating of structure paints (Material No. 16-021).
(17)Remove safety clips and tags and close circuit breakers 7SA1 and 7SA2 on panel 21VU.

R **ON A/C 001-100,

R Post SB 24-2096 For A/C 001-100,

R NOTE : The removal/installation operations for antennas 4SA1, 4SA2, 5SA1
R and 5SA2 are identical. Only the operations concerning transmission
R antenna 4SA1 are described.

R A. Job Set-Up
R (1)Position access platform.
R (2)Open, safety and tag the following circuit breakers :
R (a)For antennas 4SA1 and 5SA1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO - NAV & COM/RAD ALTM 1	7SA1	107/C 5

(b)For antennas 4SA2 and 5SA2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO - NAV & COM/RAD ALTM 2	7SA2	107/C10

B. Removal
(1)Remove the four antenna (2) attachment screws (3).
(2)Withdraw antenna (2) until coaxial connector (1) is visible and accessible.
(3)Remove sealant from shrink sleeve (6) with a non-metallic scraper.
(4)Carefully remove shrink sleeves (6) and (8) from coaxial connector (1).
(5)Disconnect coaxial connector (1) from antenna (2).
(6)Remove and clean seal (5). After inspection, discard seal if damaged.
(7)Blank coaxial connector (1) and antenna (2) receptacle.
(8)Clean areas of contact between fuselage and antenna (2).

C. Preparation
- On Radio Altimeter antenna :
(1)The replacement antenna must not show any evidence of corrosion or of protective compound. There must not be any defect.
(2)If a first visual check of the radio altimeter antenna reveals corrosion then proceed as follows :
(a)Remove any remains of sealing material.
Check antenna for corrosion.
(b)Apply stripper (Material No. 12-005) on corrosion spots of antenna mating flange.
NOTE 1 : If the visual inspection of the antennas reveals either :
- scratches on the radiating surface (circle shaped) or,
- corroded or damaged connectors or,
- red marks (mounting direction) no longer visible or,
- paint on radiating surface partly or fully flaked off,
the antenna should be replaced.
NOTE 2 : The application of paint of any type on the outer radiating surface is prohibited.
(c)Clean antenna countersunk holes.
- On aircraft fuselage (antenna area) :
(1)If a first visual check of the fuselage (antenna area) reveals corrosion, then proceed as follows :
(a)Remove any remains of sealing material.
(b)Mechanically rework corrosion spots (max. grinding depth 1 mm (0.04 in.)).
(c)Rework damaged surface with Araldite (Material No. 08-001).
(d)Polish surface.
(e)Spray fuselage areas with structure paints (Materials No. 16-001 and 16-018).

R (f)Paint antenna contact surfaces on fuselage with special materials (Material No. 05-013).
R (g)Mask mounting holes against sealing material.
R (h)Prepare contact surface on fuselage side with approximately 1 mm (0.04 in.) even depth of sealant (Material No. 09-019).
R NOTE : The sealing material has to be sufficiently fluid to fill up only gap between antenna flange and aircraft mounting support due to wavy surfaces. Remaining sealant thickness must be as small as possible.

R D. Installation
R (1)Remove blanking caps from coaxial connector (1) and from antenna (2) receptacle.
R (2)Make certain that O-ring (4) is correctly installed.
R (3)Install seal (5) between fuselage and antenna (2).
R (4)Position antenna (2).
R (5)Position and push shrink sleeves (6) and (8) over coaxial cable.
R (6)Connect coaxial connector (1) to antenna (2) and secure with adhesive (Material No. 08-048).
R (7)TORQUE coaxial connector (1) to 0.265 m.daN (23.44 lbf.in.) and secure with lacquer (Material No. 07-020).
R (8)Heat shrink sleeves (6) and (8) over both parts of coaxial connector (1).
R (9)Apply sealant (Material No. 09-001 or 09-001D) over the ends of shrink sleeves (6), (7) and also on antenna body (inner part up to the O-ring (4)).
R (10)TORQUE the three countersunk screws (3) to between 0.3 and 0.35 m.daN (26.54 and 30.97 lbf.in.) so that antenna is secured inside of fuselage skin contour.
R (11)Remove sealing material that has been squeezed out during this operation.
R NOTE : Only an extremely thin film of sealing material should now be left between the antenna flange and the fuselage.
R (12)Using a milliohmeter, apply one probe on the inner metallic area of the remaining antenna hole, and the other one on the A/C fuselage.
R (13)Check that the bonding resistance does not exceed 5 milliohms.
R (14)TORQUE the last screw (3) to between 0.3 and 0.35 m.daN (26.54 and 30.97 lbf.in.) to complete the antenna attachment.
R Remove sealing material that has been squeezed out during this operation.
R (15)Apply a bead of sealant (Material No. 09-016 or 09-008E) around antenna (2).
R (16)Apply sealant (Material No. 09-016 or 09-008E) on the screw heads to protect them.
R (17)Let the sealant cure.
R (18)Apply blue varnish (Material No. 07-001D) on the sealant of the screws.
R (19)Apply sealant (Material No. 09-016 or 09-008E) on the inner structure surface and on the anchor nuts.
R (20)Apply a bead of sealant (Material No. 09-016 or 09-008E) around the mating flanges.
R After sealant bead has fully dried, apply a protective coating of structure paints (Material No. 16-021).
R (21)Remove safety clips and tags and close circuit breakers 7SA1 and 7SA2 on

R panel 21VU.

R **ON A/C 001-100,

E. Test

NOTE : (1) The aircraft must be in an area free of all obstacles (personnel, ladders, vehicles, etc.) within a minimum radius of 5 meters from the antennas.
(2) Tests for all four antennas are identical. Parentheses show information for system 2 antenna test.

Initial conditions :
- correct electrical power supply
- forward services ventilation systems in operation
- overhead panel circuit breakers closed, particulary those associated with **NAVIGATION, MIN EQPT BAY SUPPLY/NAVIGATION** and **ECAM.**
- Aircraft in ground configuration **L/G PROX DET & RELAYS** circuit breakers closed
- **EFIS/SGU** switching in normal position (**402VU** and **406VU**)
- Perform on **EFIS INPUT TEST** (Ref. 34-71-00, P. Block 501).

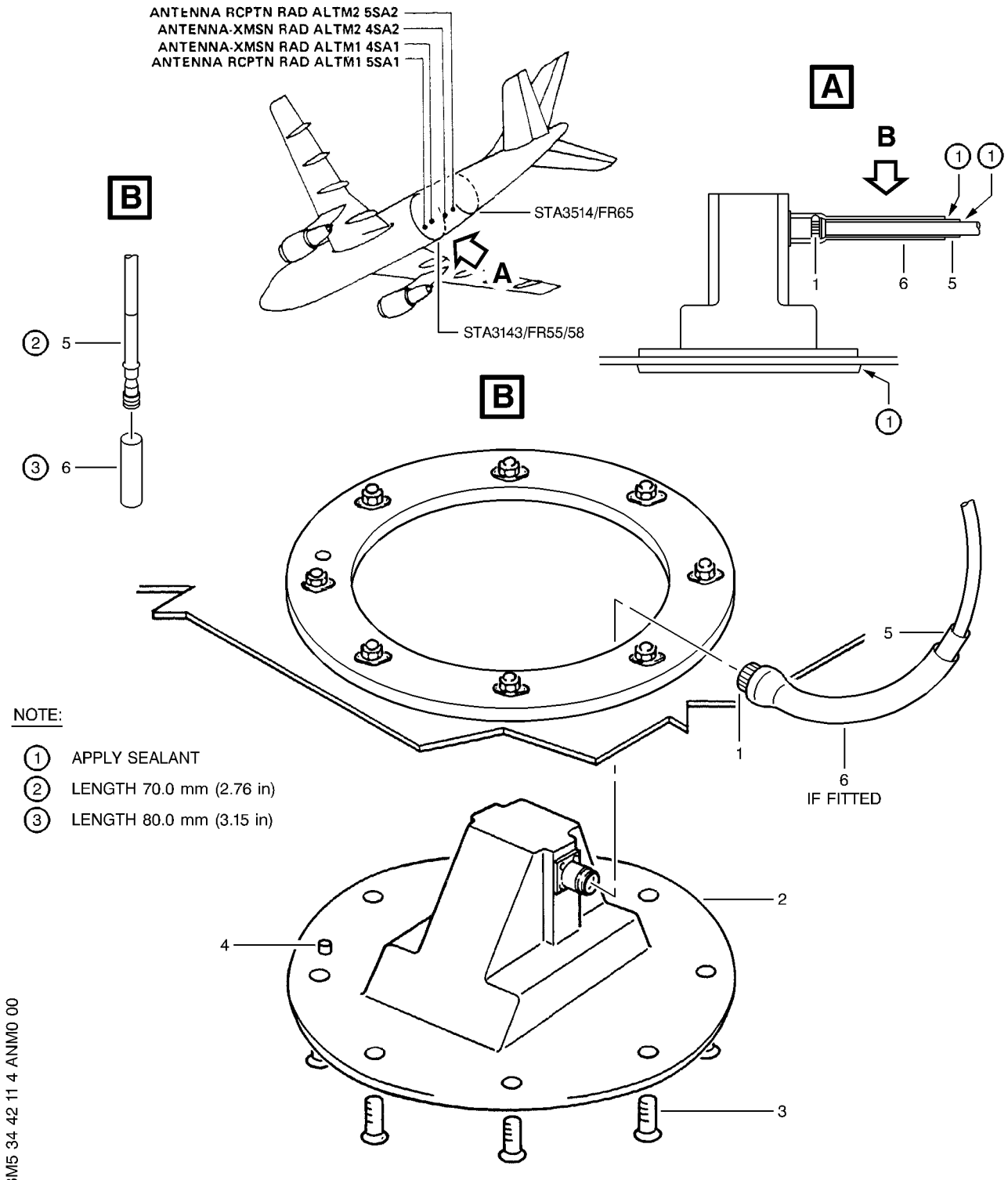
ACTION	RESULT
1. On panel 21VU, close circuit breaker **RAD ALTM 1/7SA1 (RAD ALTM 2/7SA2)**	On **CAPT** and **F/O PFD**s check that - radio height is 0 ft. - limit of radio height sector is superimposed with horizon line.

F. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Remove access platform.
(3)De-energize the aircraft electrical network. (Ref. 24-41-00, P. Block 301).

RADIO ALTIMETER TRANSMISSION AND RECEPTION ANTENNA (4SA1, 4SA2, 5SA1, 5SA2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.7 m (9.03 ft.)
B.	Circuit Breaker Safety Clips
C.	Blanking Caps
D.	Scraper - Non Metallic
E. Material No. 05-013	Special Materials (Ref. 20-31-00)
F. Material No. 08-001	Bonding and Adhesive Compound (Ref. 20-31-00)
G. Material No. 09-001	Sealants (Ref. 20-31-00)
H. Material No. 09-001D	Sealants (Ref. 20-31-00)
I. Material No. 09-016	Sealants (Ref. 20-31-00)
R or	
R Material No. 09-008E	Sealants (Ref. 20-31-00)
J. Material No. 09-019	Sealants (Ref. 20-31-00)
K. Material No. 12-005	Strippers (Ref. 20-31-00)
L. Material No. 16-001	Structure Paints (Ref. 20-31-00)
M. Material No. 16-018	Structure Paints (Ref. 20-31-00)
N. Material No. 16-021	Structure Paints (Ref. 20-31-00)
- 24-41-00, P. Block 301 (Ref. Fig. 401)	AC External Power Control



Radio Altimeter Transmission and Reception Antenna
Figure 401

R

2. Procedure

NOTE : The removal/installation operations for antennas 4SA1, 4SA2, 5SA1 and 5SA2 are identical. Only the operations concerning transmission antenna 4SA1 are described.

A. Job Set-Up

(1)Position access platform.

(2)Open, safety and tag the following circuit breakers :

(a)For antennas 4SA1 and 5SA1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO - NAV & COM/RAD ALTM 1	7SA1	107/C 5

(b)For antennas 4SA2 and 5SA2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO - NAV & COM/RAD ALTM 2	7SA2	107/C10

B. Removal

(1)Remove the eight antenna (2) attachment screws (3).

(2)Withdraw antenna (2) until coaxial connector (1) is visible and accessible.

R (3)If installed, remove sealant from shrink sleeve (6) with a non-metallic R scraper.

R (4)Carefully remove shrink sleeve (6) from coaxial connector (1).

R (5)Disconnect coaxial connector (1) from antenna (2).

R (6)Blank coaxial connector (1) and antenna (2) receptacle.

R (7)Clean areas of contact between fuselage and antenna (2).

C. Preparation
- On the Radio Altimeter antenna :
(1)The replacement antenna must not show any evidence of corrosion or of protective compound. These must not be any defect.
(2)If a first visual check of the radio altimeter antenna reveals corrosion then proceed as follows :
(a)Remove any remains of sealing material.
Check antenna for corrosion.
(b)Apply stripper (Material No. 12-005) on corrosion spots of antenna mating flange.
NOTE 1 : If the visual inspection of the antennas reveals either :
- scratches on the radiating surface (circle shaped) or,
- red marks (mounting direction) no longer visible or,
- paint on radiating surface partly, or fully flaked off,
the antenna should be replaced.
NOTE 2 : Any other severe corrosion of antenna will involve exchange/ return of antenna to manufacturer.
NOTE 3 : The application of paint of any type on the outside radiating surface is prohibited.
(c)Clean antenna countersunk holes.
- On the aircraft fuselage (antenna areas) :
(1)If a first visual check of the fuselage (antenna area) reveals corrosion, then proceed as follows :
(a)Remove any remains of sealing material.
(b)Mechanically rework corrosion spots (max. grinding depth 1 mm (0.04 in.)).
(c)Rework damaged surface with Alradite (Material No. 08-001).
(d)Polish surface.
(e)Spray fuselage areas with structure paints (Materials No. 16-001 and 16-018).
(f)Paint antenna contact surfaces on fuselage with special materials (Material No. 05-013).
(g)Mask mounting holes against sealing material.
(h)Prepare contact surface on fuselage side with approximately 1 mm (0.04 in.) or even depth of sealants (Material No. 09-019).
NOTE : The sealing material has to be sufficiently fluid to fill up only gap between antenna flange and aircraft mounting support due to wavy surfaces. Rest sealing thickness has to be as small as possible.

D. Installation
(1)Remove blanking cap from coaxial connector (1) and from antenna (2) receptacle.
(2)Raise antenna (2).
R (3)If installed, push shrink sleeve (6) over coaxial cable.
R (4)Connect coaxial connector (1) and safety plug connector nut.
R (5)If installed, shrink sleeve (6) over both parts of connector (1).
R (6)Apply sealants (Material No. 09-001 or 09-001D) over the ends of the
R shrink sleeve (6) and also on antenna body.
R (7)Push the antenna carefully into place with respect to foolproofing stud (4) so that the flange goes straight into the bed of wet sealing

material.

(8) TORQUE the countersunk screws (3) to between 0.3 and 0.35 m.daN (26.54 and 30.97 lbf.in) so that antenna is secured inside of fuselage skin contour. Remove sealing material that has been squeezed out during this operation.

NOTE : Only an extremely thin film of sealing material should now be left between the antenna flange and the fuselage.

R (9) Apply a sealing bead of sealants (Material No. 09-016 or 09-008E) around antenna (2).

(10) Seal screw heads with paint coating.
(Note that electrical conductive path from antenna to fuselage is now by screws only, every care should be taken to ensure that this path is as clean as possible, and check bonding contact resistance ($\leq 10^{-2}$ Ohms) between nuts and fuselage surface).

R (11) Apply a bead of sealants (Material No. 09-016 or 09-008E) around the
R mating flanges.
After sealant bead has fully dried, apply a protective coating of structure paints (Material No. 16-021).

(12) Remove safety clips and tags and close circuit breakers 7SA1 and 7SA2 on panel 21VU.

E. Test

NOTE : (1) The aircraft must be in an area free of all obstacles (personnel, ladders, vehicles, etc.) within a minimum radius of 5 meters from the antennas.
(2) Tests for all four antennas are identical.
Parentheses show information for system 2 antenna test.

Initial conditions :
- correct electrical power supply
- forward services ventilation systems in operation
- overhead panel circuit breakers closed, particulary those associated with **NAVIGATION, MIN EQPT BAY SUPPLY/NAVIGATION** and **ECAM.**
- Aircraft in ground configuration **L/G PROX DET & RELAYS** circuit breakers closed
- **EFIS/SGU** switching in normal position **(402VU** and **406VU).**

ACTION	RESULT
1. On panel 21VU, close circuit breaker **RAD ALTM 1/7SA1 (RAD ALTM 2/7SA2)**	On **CAPT** and **F/O PFDs** check that - radio height is 0 ft. - limit of radio height sector is superimposed with horizon line.

F. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Remove access platform.
(3)De-energize the aircraft electrical network. (Ref. 24-41-00, P. Block 301).

ANTENNA - RADIO ALTIMETER (4SA1, 4SA2, 5SA1, 5SA2) - CLEANING/PAINTING

WARNING : ISOPROPYL ALCOHOL IS CLASSIFIED AS A HAZARDOUS MATERIAL WHICH CAN CAUSE INJURY OR ILLNESS IF IT IS NOT CORRECTLY USED. REFER TO THE MANUFACTURER'S SPECIFIC SAFETY AND HEALTH RECOMMENDATIONS BEFORE YOU USE THIS PRODUCT. CAREFULLY READ THE APPLICABLE "MATERIAL SAFETY DATA SHEET" AND OBEY ALL SAFETY AND HEALTH PRECAUTIONS.

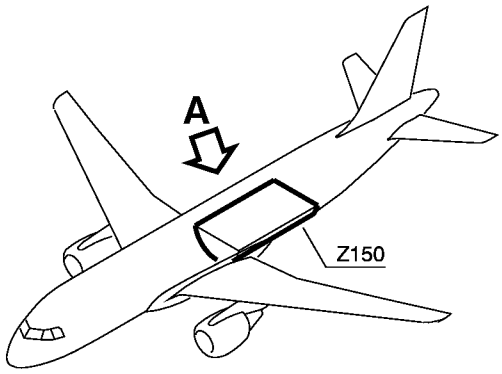
WARNING : DO NOT USE ISOPROPYL ALCOHOL NEAR FLAMES OR HEAT BECAUSE THE ALCOHOL IS FLAMMABLE. DO NOT BREATHE THE FUMES RELEASED FROM THE ALCOHOL. WEAR PERSONAL PROTECTION EQUIPMENT. USE IN A WELL VENTILATED AREA.

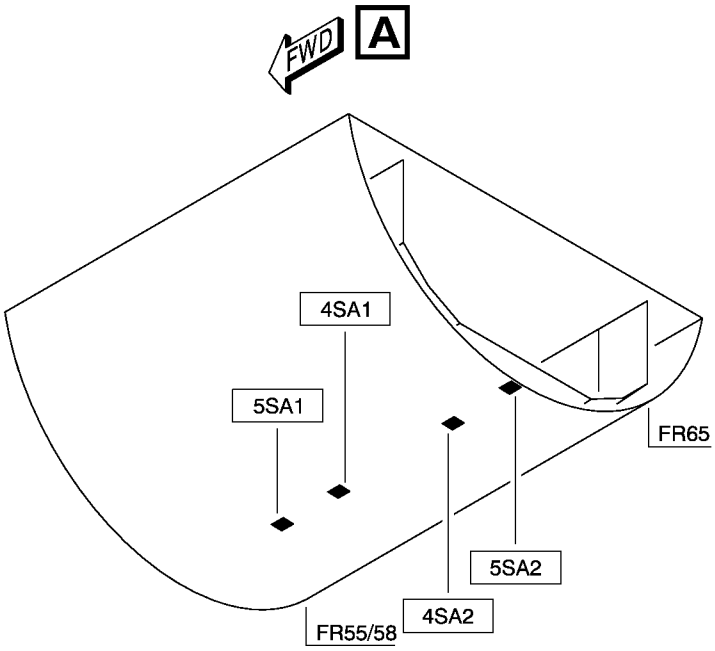
1. Reason for the Job
   To perform scheduled maintenance task on the Radio Altimeter (RA) antennas at an interval of 6 months maximum.

2. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.7 m (9.03 ft.)
B. Material No. 11-010	Isopropyl Alcohol (Ref. 20-31-00)
C. Material No. 19-003	Lint-Free Cotton Cloth (Ref. 20-31-00)

(Ref. Fig. 701)





BM5 34 42 11 7 AAC0 00

Radio Altimeter Antenna - Location
Figure 701

3. Procedure

A. Job Set-Up

(1)Position access platform.

B. Cleaning

(1)Clean the RA antennas (4SA1, 4SA2, 5SA1, 5SA2) and the adjacent area with a lint-free cotton cloth soaked in Isopropyl alcohol.

NOTE : This task should be carried out at an interval of 6 months maximum in order to ensure good operation of the Radio Altimeter System.

C. Close-Up

(1)Make sure that working area is clean and clear of tools and other items.

(2)Remove the access platform.

R RADIO ALTIMETER TRANSCEIVER (1SA1, 1SA2) - REMOVAL/INSTALLATION

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.70 m (9 ft.2 in.)
B.	Blanking Caps/Plugs
C.	Circuit Breakers Safety Clips
Referenced Procedures	
- 34-42-00, P. Block 501	Radio Altimeter
- 34-71-00, P. Block 501	EFIS/INPUTS Test

**ON A/C 001-100,

R (Ref. Fig. 401)

**ON A/C 101-200,

R (Ref. Fig. 402)

**ON A/C ALL

NOTE : Removal/Installation procedures are identical for transceivers 1SA1 and 1SA2. The procedure for transceiver 1SA1 only is described.

2. Procedure

A. Job Set-Up

R (1)Position access platform below access door 812.
R (2)Remove the following panels :
R (a)152 LW and 152KW for radio altimeter transceiver 1SA1
R (b)152 RW and 162BW for radio altimeter transceiver 1SA2.
(3)Open, safety and tag the following circuit breakers :
(a)For radio altimeter transceiver 1SA1.

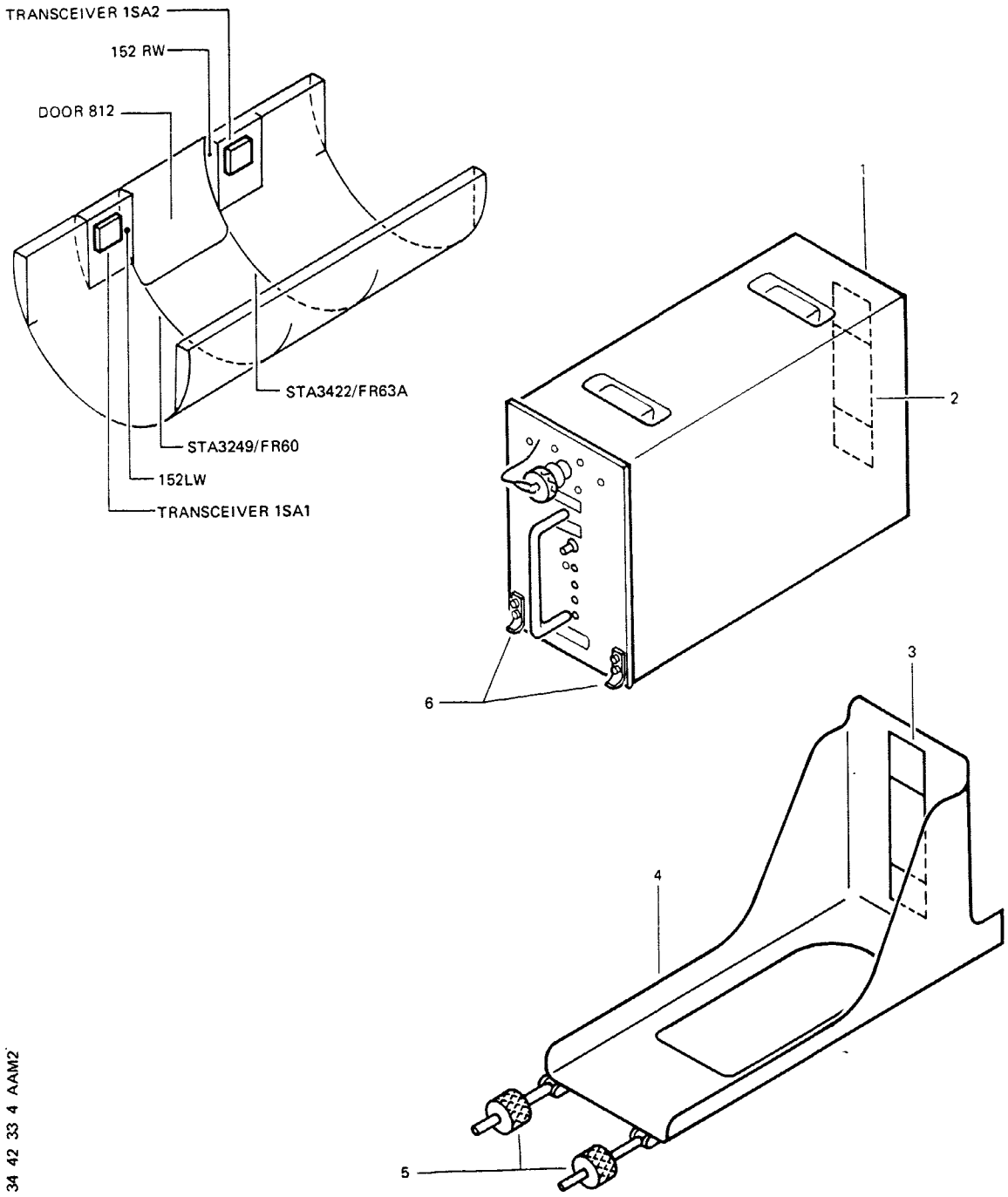
PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM RAD-ALTM1	7SA1	107/C5

(b)For radio altimeter transceiver 1SA2.

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM RAD-ALTM2	7SA2	107/C10

B. Removal

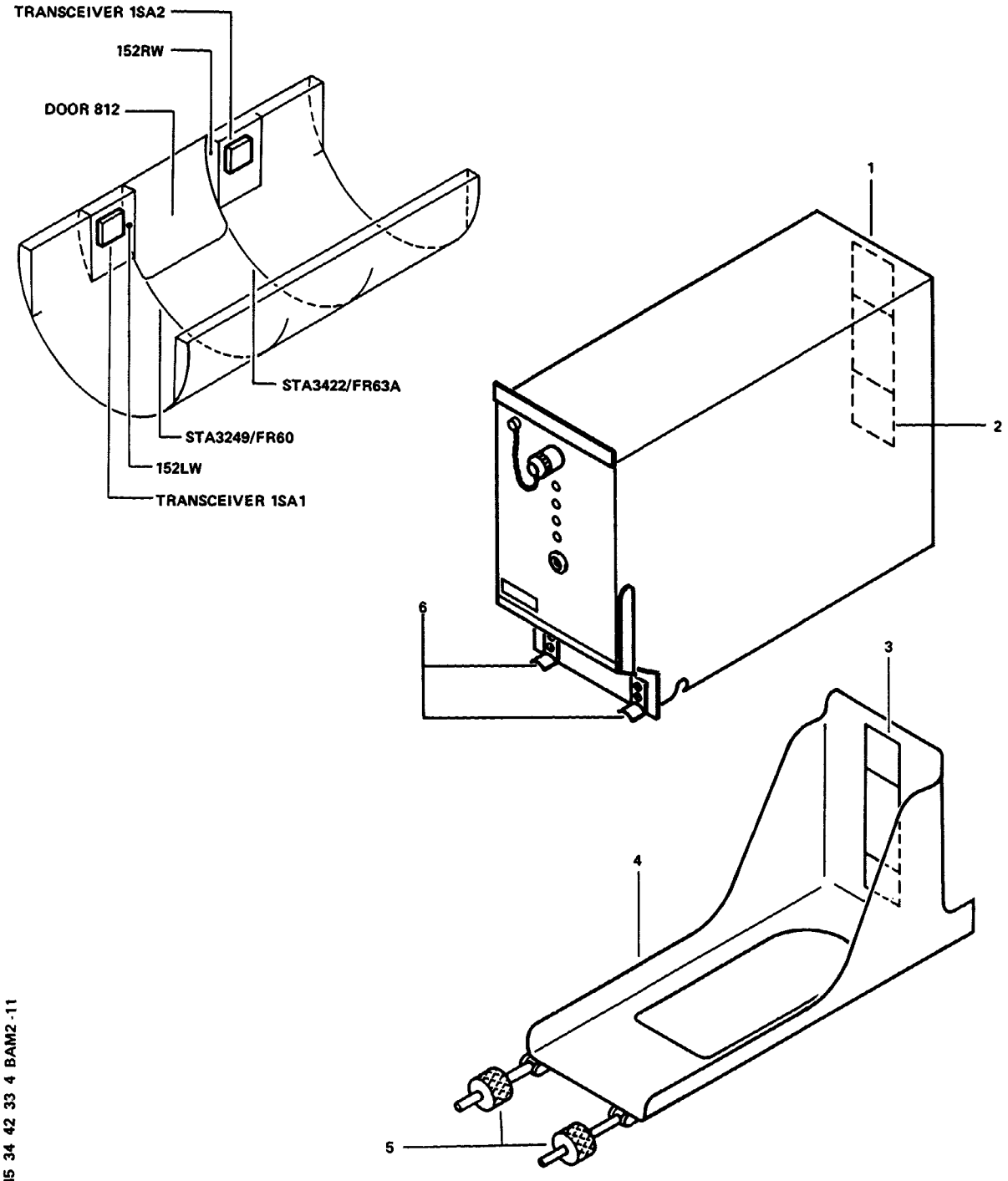
(1)Unscrew knurled nuts (5) on face of the mount (4) and pivot then downwards.
(2)Remove radio altimeter transceiver (1) from mount (4).



BM5 34 42 33 4 AAM2

R

Radio Altimeter Transceiver
Figure 401



BM5 34 42 33 4 BAM2-11

R Radio Altimeter Transceiver
Figure 402

(3)Cap connectors (2) and (3).
(4)Remove radio altimeter transceiver (1).

C. Installation
(1)Clean and inspect radio altimeter transceiver interface and/or adjacent area.
(2)Remove blanking caps from connectors and visually check condition of pins.
(3)Install radio altimeter transceiver (1) in mount (4).
R (4)Engage knurled nuts (5) in studs (6) and tighten.
(5)Remove safety clips and tags and close the following circuit breakers :
(a)7SA1 for radio altimeter transceiver 1SA1.
(b)7SA2 for radio altimeter transceiver 1SA2.

D. Test
Carry out an EFIS/INPUTS test (Ref. 34-71-00, P. Block 501) in order to restore system to initial configuration as follows :
RAD ALTM 1 ----> EFIS SGU1 ----> PFD CAPT
RAD ALTM 2 ----> EFIS SGU2 ----> PFD F/O
then an operational test of radio altimeter (Ref. 34-42-00, P. Block 501).

R E. Close-Up
R (1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
R (2)Install the following panels :
R (a)152 LW and 152 KW for radio altimeter transceiver 1SA1.
R (b)152 RW and 162 BW for radio altimeter transceiver 1SA2.
R (3)Close access door 812 and remove access platform.

COOLING FAN 9SA1 (9SA2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.7 m (8 ft. 9 in.)
B.	Circuit Breaker Safety Clips
C.	Blanking Plugs/Caps
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-71-00, P. Block 501	EFIS/INPUTS Test

(Ref. Fig. 401)

NOTE : Removal/Installation operations are identical for fans 9SA1 and 9SA2. Only removal/installation operations for 9SA1 are described.

2. Procedure

A. Job Set-Up

(1)Position access platform at access door 812.

(2)Open access door 812 and remove the following panels :

(a)152KW, for fan 9SA1.

(b)162BW, for fan 9SA2.

(3)Open, safety and tag the following circuit breakers :

(a)For fan 9SA1.

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/RAD ALTM 1	7SA1	107/C5

(b)For fan 9SA2.

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/RAD ALTM 2	7SA2	107/C10

B. Removal

(1)Disconnect and blank electrical connectors (1) and (4).

(2)Unscrew the four dzus fasteners (2) accessible from underneath mount.

(3)Remove fan assembly from mount (3).

C. Installation

(1)Clean and inspect fan interface and/or adjacent area.

(2)Position fan assembly on mount.

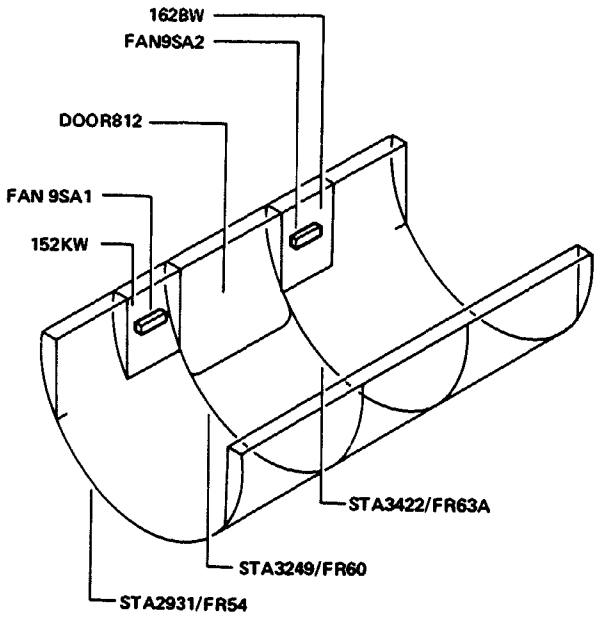
(3)Tighten the four dzus fasteners (2).

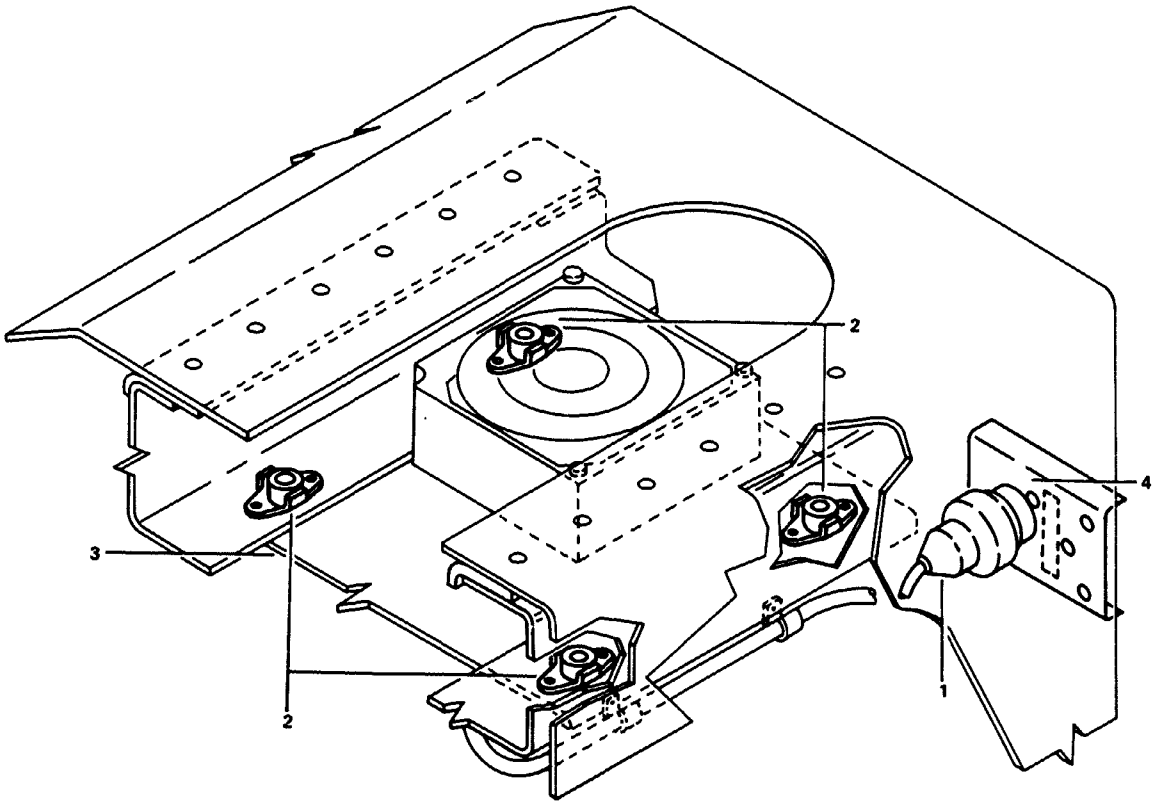
(4)Remove blanking caps and plugs from electrical connectors and check for correct condition of connectors. Connect connectors (1) and (4).

(5)Remove safety clips and tags and close the following circuit breakers.

(a)7SA1 for fan 9SA1.

(b)7SA2 for fan 9SA2.





Cooling Fan
Figure 401

D. Test
Initial conditions
- correct electrical power supply
- overhead panel circuit breakers closed, particularly those associated with **RADIO - NAV & COM.**

Check that
- fan starts operating as soon as the system is energized
- Air is blown upwards through fan case.
- Carry out an **EFIS/INPUTS** test (Ref. 34-71-00, P. Block 501) in order to restore system to initial configuration as follows :
  RAD ALTM1 ----> EFIS SGU1 ----> CAPT PFD
  RAD ALTM2 ----> EFIS SGU2 ----> F/O PFD.

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Install access panels
(a)152KW, for fan 9SA1
(b)162BW, for fan 9SA2
(3)Close access door 812 and remove access platform.
(4)De-energize aircraft electrical network (Ref. 24-41-00, P. Block 301).

COOLING FAN 9SA1 (9SA2) - CLEANING/PAINTING

1. Reason for the Job
   To clean dust from both radio altimeter blower assembly mounting trays.

2. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform 2.7 m (8 ft. 9 in.)
B.	Circuit Breaker Safety Clips
C.	Blanking Plugs/Caps
D.	Electrical Ground Power Unit - 3-phase, 115/200 V, 400 Hz, 90KVA
E.	Vacuum Cleaner
F.	Brush
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

3. Procedure

A. Job Set-Up
   NOTE : Removal/Installation operations for fan 9SA1 are described as both installations are identical.
   (1)Position access platform at access door 812.
   (2)Open access door 812 and remove the following panels :
      (a)152KW, for fan 9SA1
      (b)162BW, for fan 9SA2
   (3)Open, safety and tag the following circuit breakers :
      (a)For fan 9SA1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/RAD ALTM 1	7SA1	107/C5

      (b)For fan 9SA2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/RAD ALTM 2	7SA2	107/C10

B. Removal
   Carry out the procedure as described in AMM 34-42-43, P. Block 401, Para. 2.B.

C. Cleaning
   (1)Clean dust from mounting position, using brush and vacuum cleaner.
   (2)Clean fan assembly using vacuum cleaner.
   (3)Inspect fan interface and adjacent area for damage and condition.

D. Installation
Carry out the procedure as described in AMM 34-42-43, P. Block 401, Para. 2.C.

E. Test
Initial conditions
- correct electrical power supply (Ref. 24-41-00, P. Block 301)
- overhead panel circuit breakers closed, particularly those associated with RADIO - NAV & COM.

Check that fan starts operating as soon as the system is energized.

F. Close-Up
(1) Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2) Install access panels
  (a) 152KW, for fan 9SA1
  (b) 162BW, for fan 9SA2
(3) Close access door 812 and remove access platform.
(4) De-energize aircraft electrical network (Ref. 24-41-00, P. Block 301).

AUTOMATIC CALL OUT - DESCRIPTION AND OPERATION

1. General

The automatic call out system provides radio altitude information at landing in the form of synthetic voices
The system is operational for radio height lower than 400ft. and inhibited for H ≤ 3ft. and during climbing trajectory.

2. System Description

(Ref. Fig. 001)

A. General

Automatic call out system is included in FWS.
To perform this function, FWS :

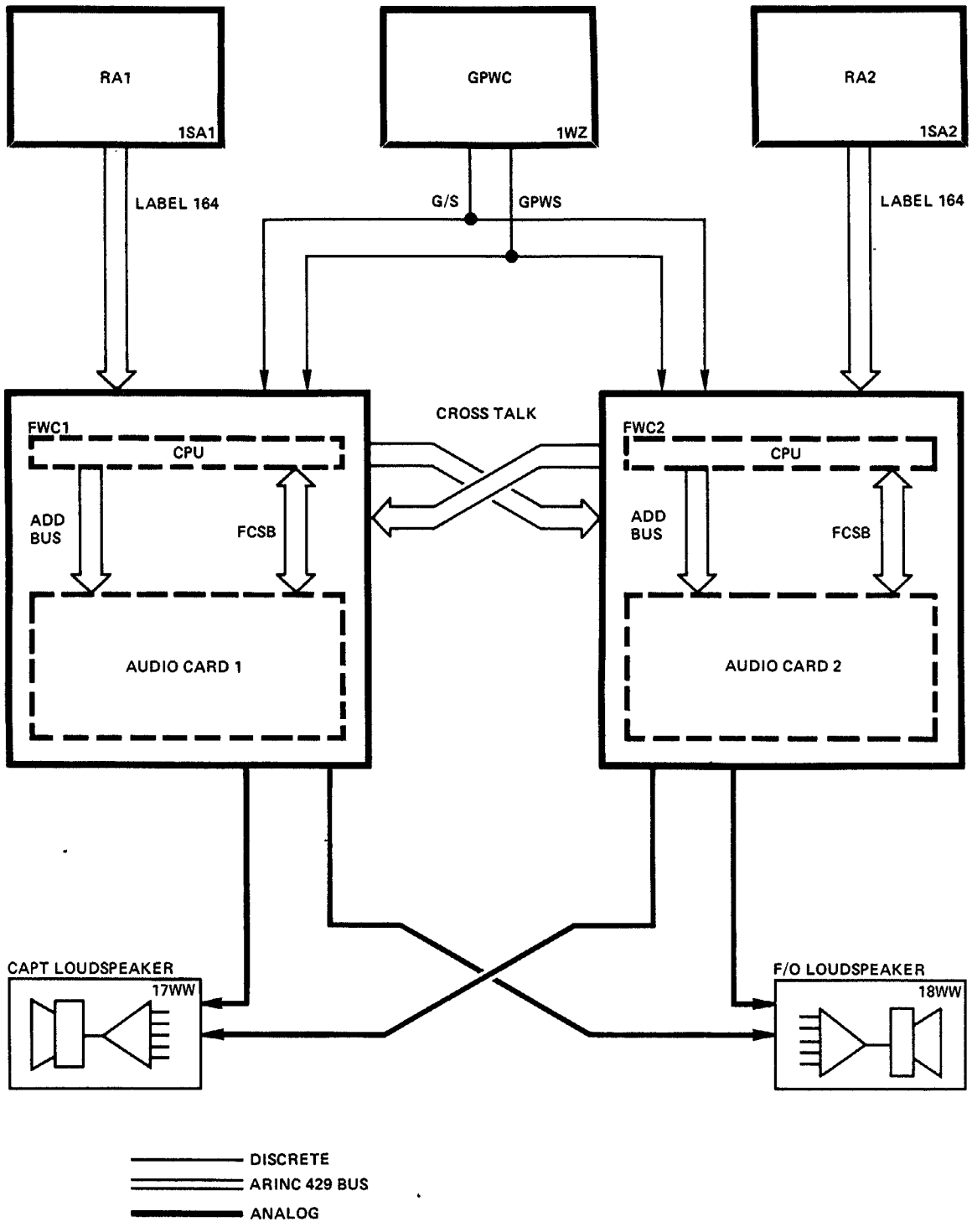
- receives digital data from radio altimeters (RA) and discrete data from GPWC,
- calculates audio and vocal warnings,
- generates (trough AUDIO CARD) these warnings,
- transmits this information to loudspeakers in flight compartment.

B. Principle of Operation

The Automatic Call-out function, processed in the FWCs, provides vocal radio height (H) information.
The system is operational for radio height lower than 400 ft.
This Automatic Call-out function is inhibited for H ≤ 3ft. and during climbing trajectory.
The radio height vocal information is triggered by the result of the comparison between radio height values and the following memorized values :

	Memorized Height Threshold	Vocal Information
R	400	Four Hundred
	300	Three Hundred
R	200	Two Hundred
R	100	One Hundred
	50	Fifty
	40	Forty
	30	Thirty
	20	Twenty
	10	Ten
	5	Five

If a new height threshold detection does not occur Ts after the previous detection, the system provides intermediate height vocal information (T = 4s for H ≤ 50ft. and T = 11s for H > 50ft.).
Between 100 and 400ft. the height value is rounded off to the lower ten.
To prevent nuisances from ground configuration the 400, 300, 200, 100 thresholds cannot be repeated less than 5 s after a previous emission.
Furthermore this function is able to provide the vocal information



BM5 34 43 00 0 BAM0 - 18 - 13
DM5

System Architecture
Figure 001

"minimum", at decision height (DH).
By aircraft wiring, the Automatic Call-out function provides the following possibilities :
- inhibition of any memorized Height Threshold
- "Plus hundred" at DH + 100.
- "Minimum" at DH.
- Priority of the ground proximity warning system over the automatic call-out function.

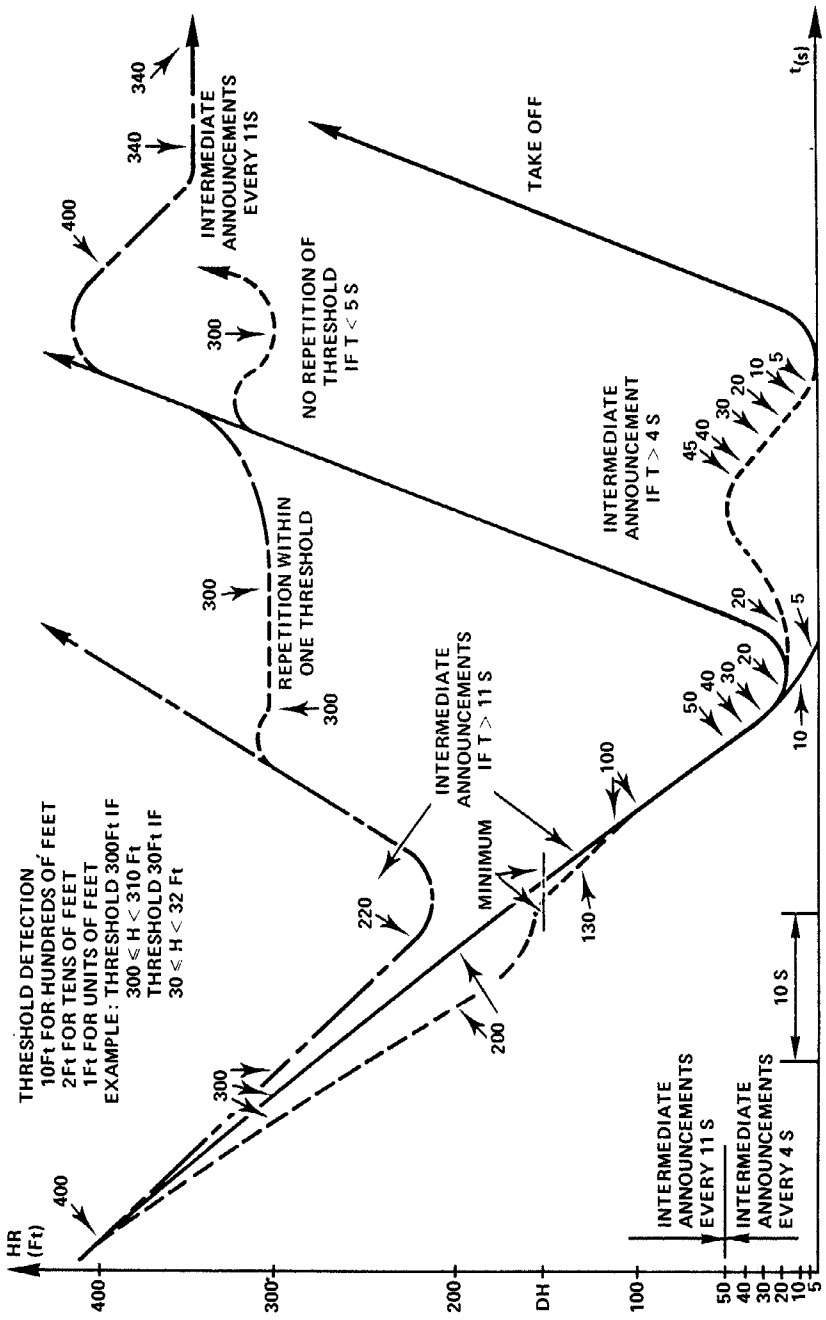
The following figure shows the diagram of the announcements for various trajectories.
(Ref. Fig. 002)

3. Functional Description

A. General
(Ref. Fig. 003)
Automatic Call Out System may be divided into two parts
- acquisition and processing of data from peripheral systems : CPU part ;
- generation of vocal announcements : AUDIO CARD vocal unit part.

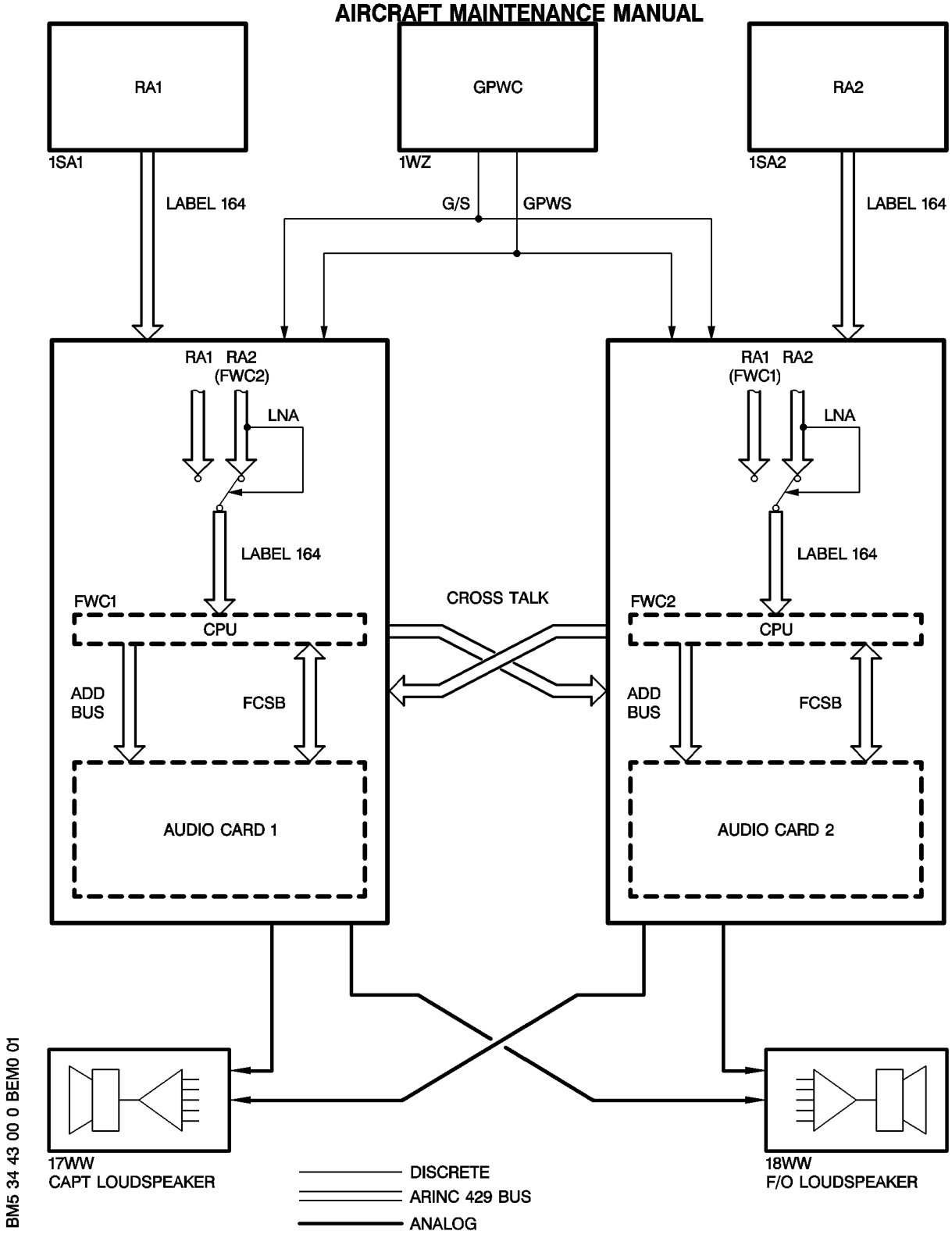
B. CPU Part
CPU receives :
- discrete data from GPWC (GPWC priority).
- ARINC messages from Radio Altimeters (RA1 for FWC1 and RA2 for FWC2).

NOTE : Exchanges between two FWCs are made by cross talk.



BM5 34 43 00 0 STC0-18-13
DM5

Call Out Configurations
Figure 002



FWC - Simplified Block Diagram
Figure 003

(1)Discrete input characteristics

(a)Input interfaces

The inputs are coupled to the microprocessor data bus through eight bit input buffers.

Each input is made up of a wired filter network which ensures decoupling between the external circuit and the integrated input circuit.

A time delay of about 10 ms eliminates voltage transients and noises induced in the wiring.

Each input in perodically tested. The test signal is at logic 1 status in normal operation. During test, this signal is set to 0, which causes an inversion of the input signal. The input is considered valid when a change of status occurs between the values acquired before and during the test.

(Ref. Fig. 004)

(b)System inputs

Two inputs are used in relation with GPWS.

- one GPWS input
- one G/S input

These inputs correspond with the illumination of G/S and GPWS indicator lights on center instrument panel in the flight compartment. When GPWS PRIORITY input is connected to +15V and either G/S or GPWS signal is present, all call outs above 50ft. are inhibited.

(Ref. Fig. 005)

(c)Inhibition inputs

Discrete inputs are used for call out inhibition. These inputs are either connected to +15V (inhibition) or grounded through external wiring.

Each CPU has five inhibition inputs. Following table indicates inhibition input possibilities :

FWC1 INPUT	FWC2 INPUT	TERMINAL	TERMINAL +15V INHIBITION	GND TERMINAL NON INHIBIT
INHIBIT 400	INHIBIT 40	LMP 2H	LMP 5A	RMP 5K
INHIBIT 300	INHIBIT 30	LMP 2D	LMP 4A	RMP 4K
INHIBIT 200	INHIBIT 20	RTP 13J	LMP 3A	RMP 3K
INHIBIT 100	INHIBIT 10	RTP 12G	LMP 2A	RMP 2K
INHIBIT 50	INHIBIT 5	RTP 11H	LMP 1A	RMP 1K

Information of inhibition between the two FWCs is made by cross talk.

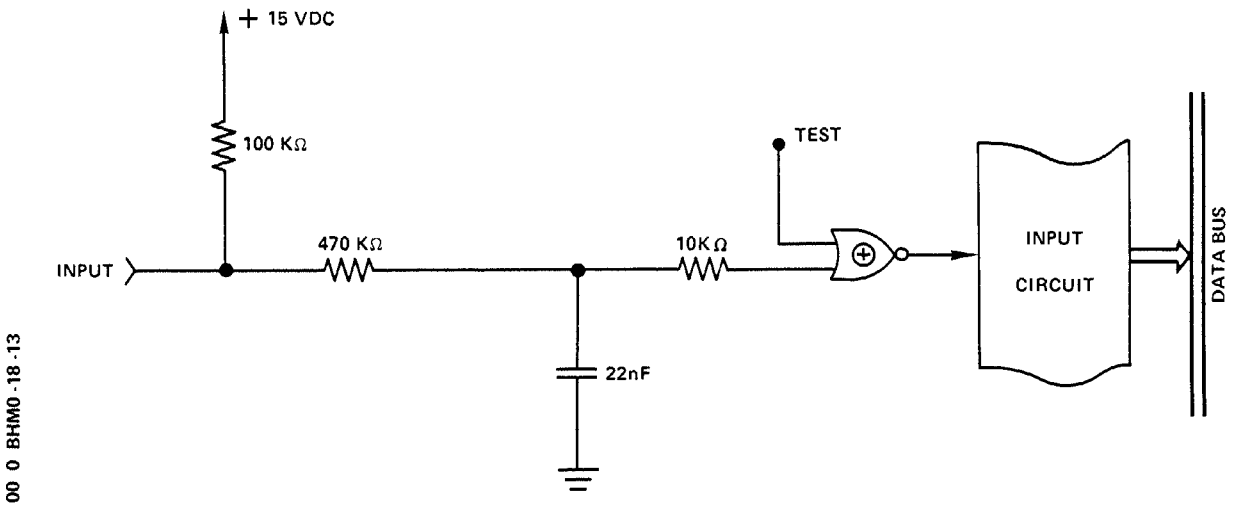
(2)ARINC 429 inputs

ARINC 429 message reception is made by 4 RTA (Receive Transmitter ARINC) circuits, each of them composed of 4 channels.

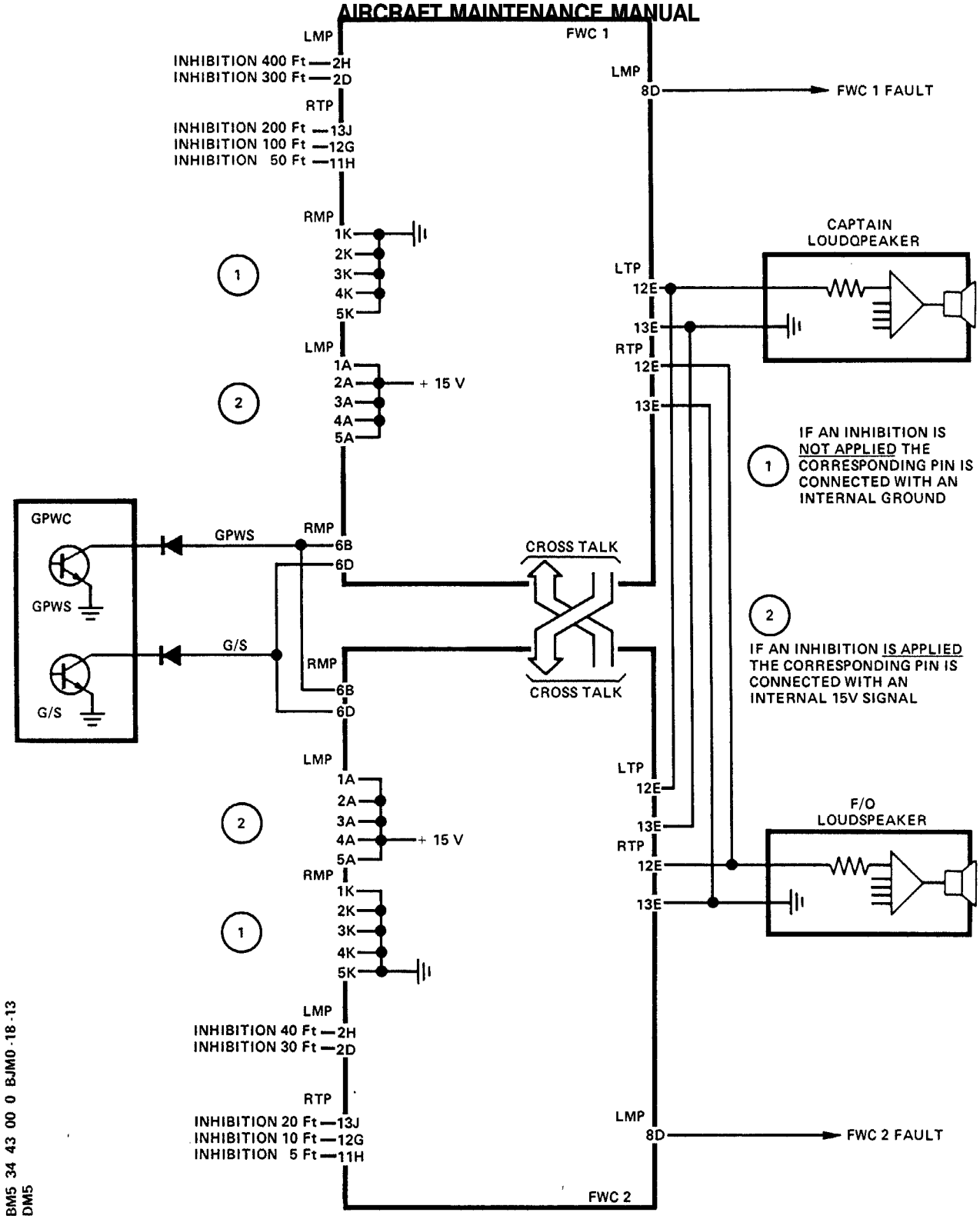
A 2K octet RAM enables to store 500 different messages.

Access by the CPU into the RAM is made in asynchronosus mode, when ARINC processor permits reading by particular signal.

Moreover verification of correct operation of the 16 channels is made by a test with a RTA used as transmitter.



Input Circuit
Figure 004



FWC - Automatic Call Out System - Input/Output Connections
Figure 005

(3)System BUS (FCSB)
Exchanges between CPU and AUDIO CARD are made through FCSB BUS.
(4)Output characteristics
(Ref. Fig. 005)
(a)Discrete outputs
MASTER WARN and MASTER CAUTION lights are connected to each FWC.
Two lights (FWC 1 and FWC 2 FAULT) located on rear panel indicate loss of redundancy, system remaining integrally operational.
(b)Cross talk
Information exchanges between FWCs are made by cross talk in the form of ARINC 429 messages.

C. AUDIO CARD

AUDIO CARD is made of 3 parts which achieve following functions :

- interface registers with FCSB bus ;
- audio unit (not described in this chapter),
- vocal unit.

(Ref. Fig. 006)

(1)Interface registers with FCSB bus

CPU card communicates with Audio Card through FCSB bus ; the information passes through one of the six 8 bit registers located on Audio Card.

- command register :
  only write register in which CPU card specifies operation modes to vocal and audio units.
- status register :
  only read register which contains answers of Audio Card.
- input /output registers :
  these bi-directional registers allow exchange of data between CPU and Audio Cards. Each unit (vocal and audio) is supplied by two 8 bit registers.
  For vocal unit :
  . VDI : Vocal Data In = From CPU to Audio Card
  . VDO : Vocal Data Out = From Audio Card to CPU.

Moreover, exchanges betweeen CPU and Audio Card may be made through IT1 line (Interrupt line) of FCSB bus. This occurs when :

- VDI register empty
- VDO register full.

(2)Vocal unit

Vocal unit is built around microprocessor MC6802.
It generates words or sentences asked by CPU card.
These are realized from coded information by the Voice Synthesis Processor. The circuit is followed by a 6th order low pass filter.
Vocabulary is contained in an E2PROM.
A watch dog formed by a monostable activates NMI line of microprocessor in case of interruption in the program.
In this case, VFAULT line of status register is activated.
Exchanges with FCSB bus are made through VDI and VDO registers, and through status and command registers.

(3)Generation of HF signal

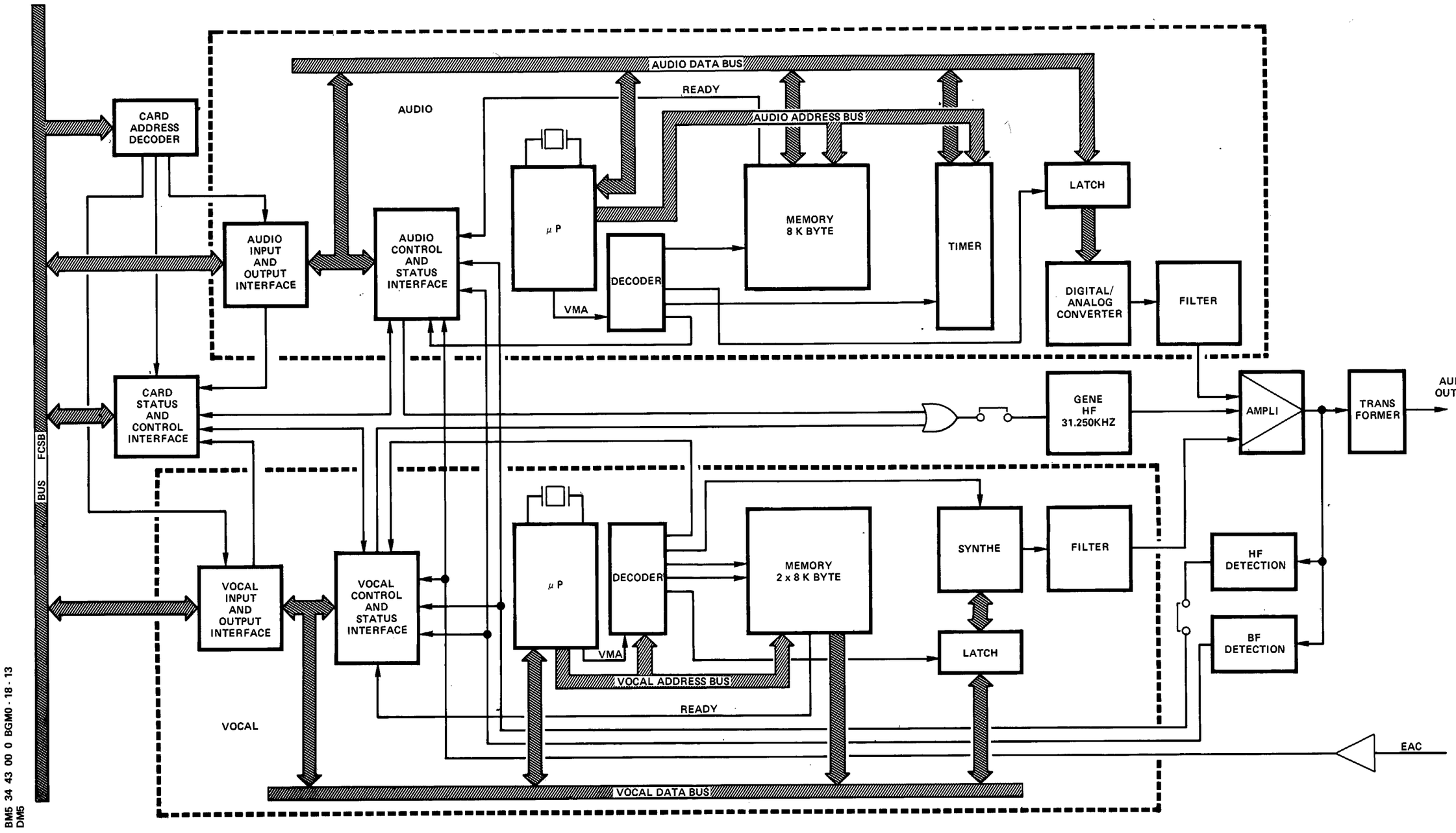
A part common to audio and vocal units consists of a 32 KHz generator, HF and BF detectors. These detectors may verify that emission is right.

(4)Input/Output signals

(a)Discrete input : Audio Card Vocal Unit receives discrete input from : EAC (Emergency Audio Cancel), which stops generated announcement immediately.

(b)Analog Output : Audio Card comprises two outputs : one for each loudspeaker in flight compartment.
The output power of each channel is 0.05W for 600 Ohms.
As each loudspeaker receives signals from both FWCs, priority is given to first arrived one.

4. Operation



AUDIO CARD - Functional Diagram
Figure 006

A. Exchanges Protocol

Data exchanges between AUDIO CARD vocal unit and CPU are made through four 8 bit registers.

- one IN data register (write)
- one OUT data register (read)
- one command register
- one status register

(1)Data characteristics

Data are of the data block type.

A data block is formed by series of ASCII standard characters in following type :

B NN AAAA DD.... DD CC E

with :

B : character of block beginning

NN : number (in Hexa) corresponding to number of octets to be transmitted

AAAA : address (in Hexa) of first octet

DD : Data value

CC : ones complement of the sum of address data, data and number of data

E : character of block end.

(2)Functional modes

4 functional modes may be selected by CPU : voice synthesis, status, programming, read ones.

The selection is realized through command register.

B. Operation

(1)Initialization phase

At switching on or in case of reset, AUDIO CARD command and status registers are reset, in order to :

- reset IT1 interrupt line,
- place vocal unit in OO mode, i.e in voice synthesis generation mode.

Then, and as long as AUDIO CARD vocal unit is not called by CPU, vocal microprocessor runs test programs to verify correct operation of its unit.

These programs may be interrupted by writing by CPU in VDI register. Then vocal unit runs program corresponding to code written in VDI register. When order has been carried out, vocal unit transmits end signal through VDO register, and runs again test programs until new CPU order.

(2)Generation of BF signal

(a)Altitude decoding

Altitude data are decoded by ARINC card, and stored in memories. CPU microprocessor reads these memories through FCSB bus, and compares the data with reference ones kept in EPROM.

For non inhibited altitudes, it generates orders it sends to AUDIO CARD vocal unit address.

(b)Voices Synthesis

To perform announcement, CPU has to specify address (or addresses) of word (or words) to be synthesized. This information is transmitted in VDI register in the form of ASCII character block, as shown below :

Data block : B NN SYNT HHLL HHLL.... HHLL CC E
with :
B : character of block beginning
NN : number (in Hexa) of octets HH LL
SYNT : series of 4 Hexa characters indicating that it is synthesis block
HH : address high-order octet of word to be synthesized
LL : address low-order octet of word to be synthesized
CC : ones complement of sum of data, SYNT word and data numbers
E : character of block end.

When block transfer is terminated, vocal unit writes status octet in VDO to indicate to CPU result of block transmission. In case of error, vocal unit ignores order.

Vocal unit microprocessor reads in EPROM memory, at indicated adresses, words to be synthesized.

Words beginning addresses of which are sent consecutively in the same block are concatenated.

During synthesis, vocal unit refreshes permanently VDO register indicating work in progress.

If CPU wants to stop synthesis, it sends character in VDI.

Emission is stopped immediately.

1. Operational Test

A. Reason for the Job
Check of synthesized voice, and RA automatic switching.

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-71-00, P. Block 501	EFIS (INPUT Test)

C. Procedure
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(1)Job set-up
- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers particulary those associated with NAVIGATION, RADIO NAV & COM and ECAM.
- Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (aircraft in ground configuration, engine stop, engine fuel levers in off position).
- On overhead panel, place MSU 1 and 2 selector switch in NAV position and wait until the altitude data are displayed on CAPT and F/O PFDs.
- On ECAM control panel, use LEFT DISPLAY knob for L ECAM display unit brightness adjustment and make certain that legends of ECAM SGU 1 & 2 pushbutton switches are off.

(2)Test
The test described below concerns side 1. For test of side 2, read information in parantheses.

ACTION	RESULT
1. On maintenance panel 470VU, - press EFIS/INPUT/TEST pushbutton switch (Ref. 34-71-00, P. Block 501). - release EFIS/INPUT/TEST pushbutton switch	On CAPT and F/O PFDs check that, - the messages concerning LRRA1 and LRRA2 inputs test of EFIS/SGU1 and EFIS/SGU2 are not displayed.
2. On maintenance panel 470 VU - press and hold RAD ALTM 1 (2) pushbutton switch - release RAD ALTM 1 (2) pushbutton switch	On CAPT (F/O) PFD check that, - limit of sector 2 moves downwards with respect to horizon line - radio height is 40 ±5 ft. R - FORTY is not heard (is heard) R in CAPT and F/O loudspeakers) - limit of sector 2 moves upwards to horizon line

ACTION	RESULT
	- radio height is approximately 0 ft.
R R 3. On panel 21VU, open circuit breaker 7SA1 line 107/C5 (7SA2 line 107/C10).	- MASTER CAUTION lights come on. - Single chime sounds. - On left ECAM display unit, the following message is displayed : NAV ADC RA1 FAULT (RA2 FAULT).
R 4. On maintenance panel 47OVU - press and hold RAD ALTM 2 (1) pushbutton switch	On CAPT and F/O PFDs check that, - limit of sector 2 moves downwards with respect to horizon line - radio height is 40 ft. ± 5 ft.
R	- FORTY is heard in CAPT and F/O loudspeakers
- release RAD ALTM 2 (1) pushbutton switch	- limit of sector 2 moves upwards to horizon line - radio height is approximately 0 ft.
R 5. On panel 21VU, close circuit breaker 7SA1 line 107/C5 (7SA2 line 107/C10).	- warnings go off.

(3)Close-up
(a)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Restore system and aircraft to normal operating condition.

2. Functional Test

A. Reason for the Job
This test is carried out in addition to the operational test to check correct operation of :
- announcements
- inhibitions.

B. Equipment and Materials

ITEM	DESIGNATION
(1)9599-607-15902	Radio Altimeter Simulator TRT SIM 530
**ON A/C 101-200,	
(2)99A34301101400	Adaptor Box - Test Set, Radio Altimeter TRT SIM 530
R Referenced Procedure	
R - 24-41-00, P. Block 301	AC External Power Control
**ON A/C ALL	

R

C. Procedure
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED. MAKE CERTAIN THAT THE PROTECTIVE COVERS ARE REMOVED FROM SENSORS AND PITOT PROBES.

(1)Job set-up
- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers particulary those associated with NAVIGATION, RADIO NAV & COM and ECAM.
- Open L/G PROX DET & RELAYS circuit breakers on panel 133VU (aircraft in flight configuration).
- On ECAM control panel use LEFT DISPLAY knob for L ECAM display unit brightness adjustment and make certain that legends of ECAM SGU 1 & 2 pushbutton switches are off.

**ON A/C 001-100,

- On L and R instrument panels make certain that EFIS/SGU and PFD/ND XFR pushbutton switches are in normal position (released).

**ON A/C 101-200,

- On L and R instrument panels make certain that EFIS/SGU pushbutton switch is in normal position (released).

R **ON A/C ALL

- Make certain that EFIS is operating and adjust PFDs and NDs image brightness on panels 412VU and 413VU.

R **ON A/C 001-100,

(a)On First Officer console 7VU
- Connect harness W 3 to RAD ALT TEST connector 1275VC(rear panel) and to TEST connector on radio altimeter simulator SIM 530.

R **ON A/C 101-200,

(a)On panel 131VU
- Connect TRT/COLLINS adaptator to RAD ALT TEST connector 1275VC and to harness W3.
- Connect this one to radio altimeter simulator SIM 530.

R **ON A/C ALL

(b)On radio altimeter simulator
- Turn - + potentiometer to - stop.
- Place D/A output selector switch in SIM position.
- Place RA DISPLAY SELECT selector switch in position 2 for radio altimeter system 2.
- In REMOTE TEST ALTITUDE windows select 0500 for UPPER
  10 for SLOPE
  +0 for LOWER.
- In REMOTE TEST automatic simulator, select a descent ramp by means of the two LH selector switches.
- Place ON/OFF switch in ON position.

(2)Test
To prevent announcements being disturbed by the sound heard when selected DH is reached.
- On CAPT and F/O EFIS control panels, press DH pushbutton switch and using SET knob, select a decision height of 600 ft.

(a)Announcements
1 Descent ramp without DH selected

ACTION	RESULT
1. On radio altimeter simulator - press START pushbutton switch briefly	On CAPT and F/O PFDs - altitude indication decreases from 500 ft. to 0 ft. in 50 sec. approx. Check that the following announcements (synthesized voice) sound in CAPT and F/O loudspeakers

ALTITUDE	ANNOUNCEMENT
400 ft.	FOUR HUNDRED
300 ft.	THREE HUNDRED
200 ft.	TWO HUNDRED
100 ft.	ONE HUNDRED
50 ft.	FIFTY
40 ft.	FORTY
30 ft.	THIRTY
20 ft.	TWENTY
10 ft.	TEN

R **ON A/C 001-100,

5 ft.	FIVE

R **ON A/C ALL

NOTE : If the descent is less rapid or interrupted, intermediate announcements are displayed (ex : 150 ft.) and an inhibited announcement is activated for the flight level after 11 s (H > 50 ft.) or 4 s (H ≤ 50 ft.)

R **ON A/C 001-100,

2 Descent ramp with DH selected
On CAPT EFIS control panel
- Press DH pushbutton switch and using SET knob select decision height (DH) of 150 ft. These data are displayed in the right lower corner of the CAPT PFD.

On F/O EFIS control panel
- Press DH pushbutton switch and using SET knob select decision height (DH) of 50 ft. These data are displayed in the right lower corner of the F/O PFD.

ACTION	RESULT
1. On radio altimeter simulator - press START pushbutton switch briefly	On CAPT and F/O PFDs - altitude decreases from 500 ft. to 0 ft. Check when altitude reaches 250 ft. (DH + 100 ft.), that PLUS HUNDRED announcement is heard in CAPT and F/O loudspeaker then stops. Check, when altitude reaches 165 ft. (DH + 15 ft.), that MINIMUM announcement is heard in CAPT and F/O loudspeakers then stops. Check, when altitude reaches 55 ft. (DH + 5 ft.), that MINIMUM announcement is heard in CAPT and F/O loudspeakers then stops.

R **ON A/C 101-200,

2 Descent ramp with DH selected
On CAPT EFIS control panel
- press DH pushbutton switch and using SET knob select decision height (DH) of 150 ft. These data are displayed in the right lower corner of the CAPT PFD.
On F/O EFIS control panel
- press DH pushbutton switch and using SET knob select decision height (DH) of 50 ft. These data are displayed in the right lower corner of the F/O PFD.

ACTION	RESULT
1. On radio altimeter simulator - press START pushbutton switch briefly	On CAPT (F/O) PFDs - Altitude indication decreases from 500 ft. to 0 ft. Check, when altitude reaches 165 ft. (DH + 15 ft.), that MINIMUM announcement sounds in CAPT and F/O loudspeakers then stops. Check, when altitude reaches 55 ft. (DH + 5 ft.) that MINIMUM announcement sounds in CAPT and F/O loudspeakers then stops.

R **ON A/C ALL

(b)Inhibitions in climb ramp (takeoff and go around)
1 Takeoff
On CAPT and F/O EFIS control panels
- release DH pushbutton switches.
On radio altimeter simulator
- in REMOTE TEST automatic simulation, select a climb ramp by means of the two LH selector switches.

ACTION	RESULT
1. On radio altimeter simulator - press START pushbutton switch briefly.	On CAPT and F/O PFDs - altitude indication increases from 0 ft. to 500 ft. Check that no announcement is heard in CAPT and F/O loudspeakers.

2 Go around
On radio altimeter simulator
- in REMOTE TEST ALTITUDE windows select +10 for LOWER.
- in REMOTE TEST automatic simulation select the continuous

symmetrical ramp (climb and descent) by means of the two LH selector switches.

ACTION	RESULT
1. On radio altimeter simulator - press START pushbutton switch briefly.	On CAPT and F/O PFDs - altitude indication increases from 0 ft. to 500 ft. then decreases from 500 ft. to 10 ft. and then increases up to 500 ft. Check that during climb no announcement is heard in CAPT and F/O loudspeakers.

D. Close-Up
(1) On radio altimeter simulator, place ON/OFF switch in OFF position.
(2) De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(3) Restore system and aircraft to normal operating condition.

1. General

The TCAS (Traffic Collision Avoidance System) is a system whose function is to detect and display aircraft in the immediate vicinity and to provide the flight crew with indications to avoid these intruders by changing the flight path in the vertical plane only.

The TCAS computer receives data from :

- ATC1 and ATC2 (MODE S) Transponders
- RA1 and RA2 (Radio Altimeters)
- IRS1 (Inertial Reference System)
- ADC1 and ADC2 (Air Data Computers)
- FWC1 and FWC2 (Flight Warning Computers)
- GPWS (Ground Proximity Warning System)
- Ground/Flight Relays

The TCAS sends information to

- CAPT and F/O VSI/TCAS (Vertical Speed/Traffic Collision Avoidance System) indicators
- DFDAU (Digital Flight Data Acquisition Unit).

The TCAS computer sends synthetic voice messages to the loudspeakers in the flight compartment.

2. Component Location

R **ON A/C 005-100,

(Ref. Fig. 001)

R **ON A/C 101-200,

R (Ref. Fig. 002)

R **ON A/C 005-100,

(Ref. Fig. 003)

R **ON A/C 101-200,

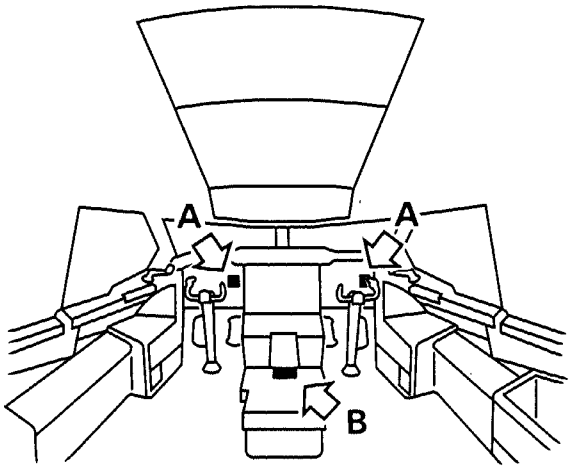
R (Ref. Fig. 004)

R **ON A/C 005-200,

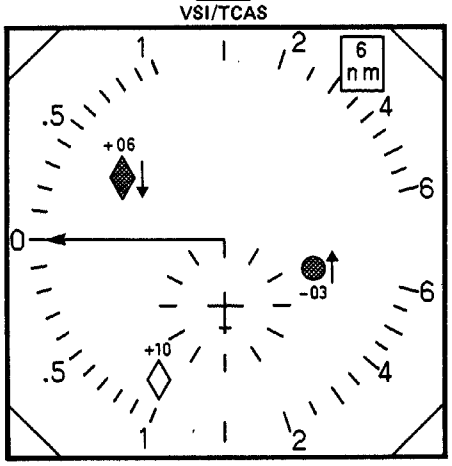
(Ref. Fig. 005)

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
1SG	COMPUTER-TCAS	500VU	121	121BL	34-44-34
7SG1	ANTENNA-TCAS, TOP		233		34-44-11
7SG3	ANTENNA-TCAS, BOTTOM		133		34-44-11
4SH	CONTROL UNIT-ATC/TCAS	11VU	211		34-52-13
4SG	C/B - TCAS	21VU	211		
R **ON A/C 101-200,					
7SH	P/BSW-AVIONICS SYS TEST/ATC/TCAS	470VU	211		
R **ON A/C 005-200,					
15FL1	INDICATOR-VSI/TCAS, CAPT	3VU	211		34-14-21
15FL2	INDICATOR-VSI/TCAS, F/O	5VU	211		34-14-21

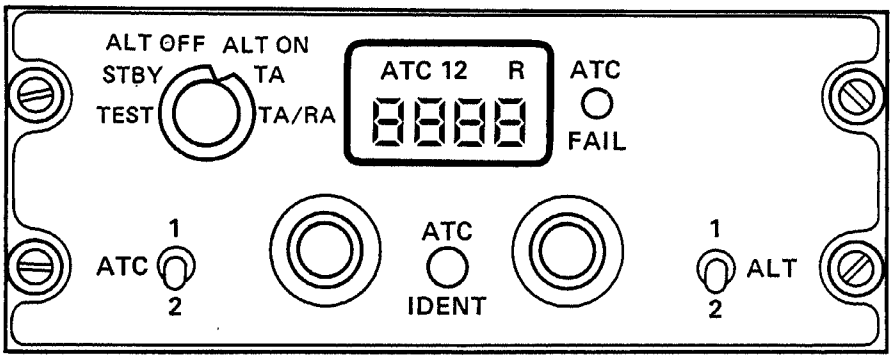
NOTE : For system components which are mentioned but not described in detail, please refer to :
ADS : Ref. 34-11-00
VSI/TCAS : Ref. 34-14-00
IRS : Ref. 34-20-00
RA : Ref. 34-42-00
GPWS : Ref. 34-48-00
DME : Ref. 34-51-00
ATC : Ref. 34-52-00



A
VSI/TCAS

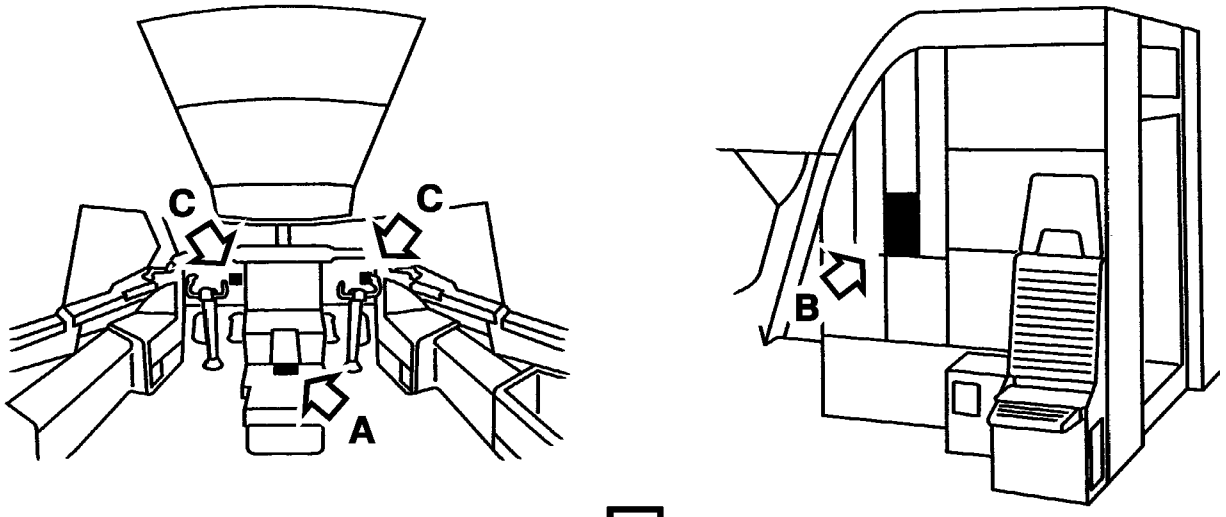


B
ATC/TCAS CONTROL UNIT



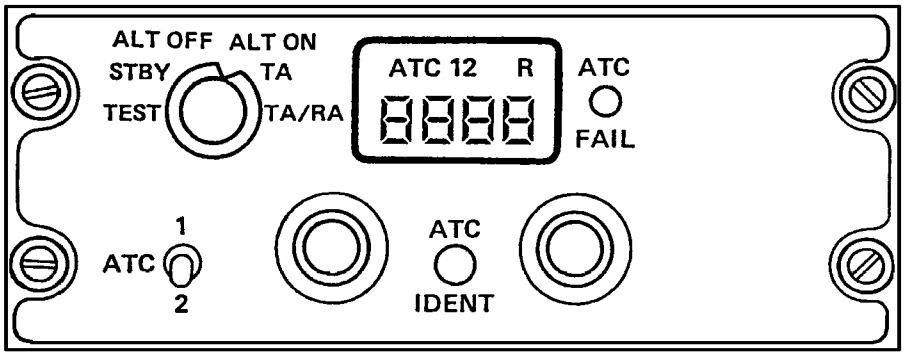
BM5 34 44 00 0 ACN0-00

TCAS - Component Location in Flight Compartment
Figure 001



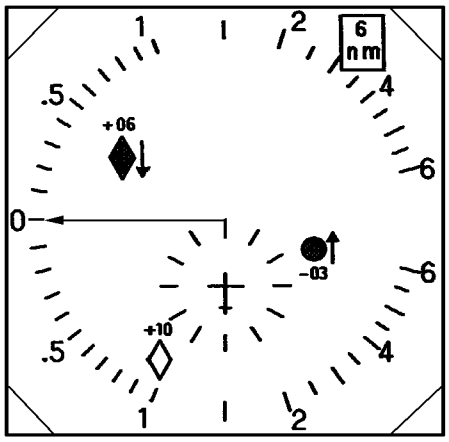
A

ATC/TCAS CONTROL UNIT

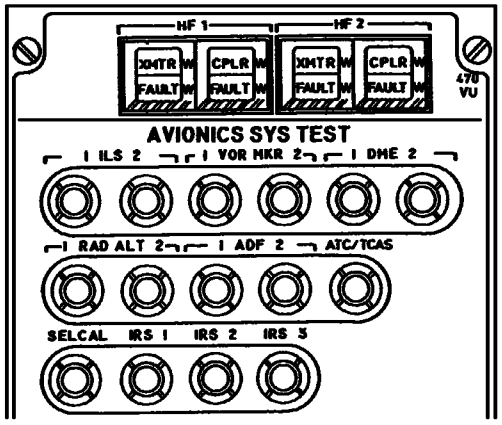


C

VSI/TCAS

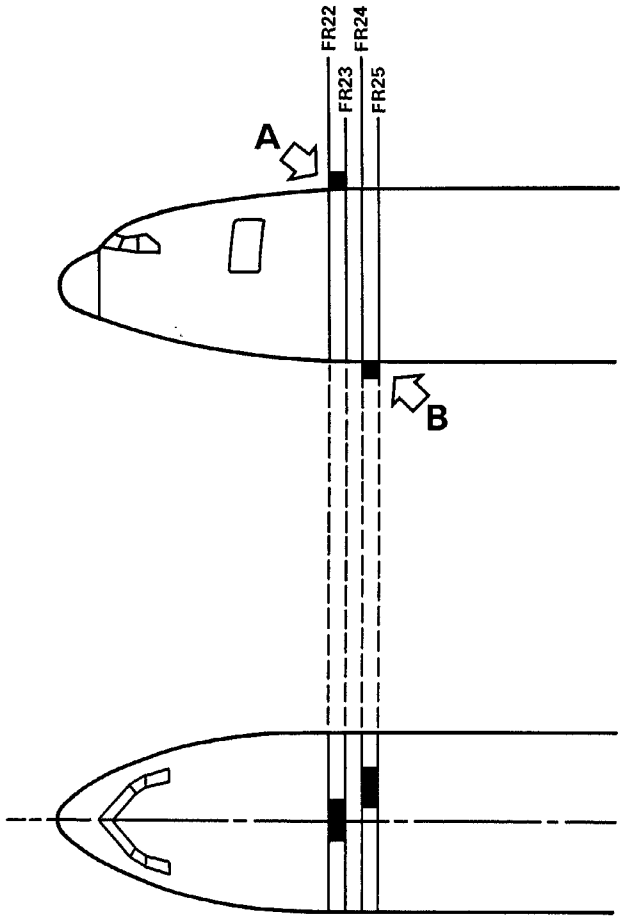


B



BM5 34 44 00 0 ACB0 00

TCAS - Component Location in Flight Compartment
Figure 002



A

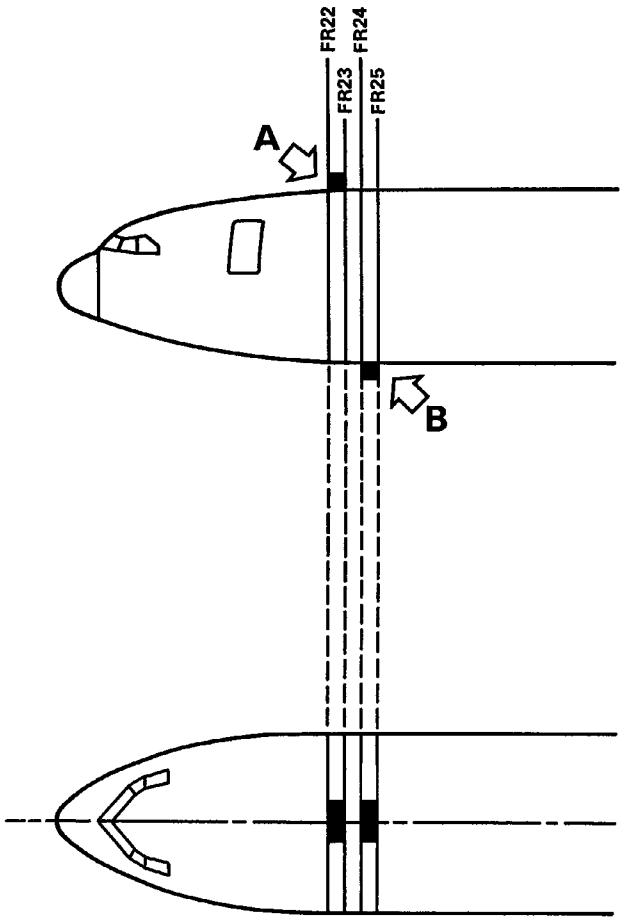
7SG1
TOP TCAS ANTENNA

B

7SG3
BOTTOM TCAS ANTENNA

BM5 34 44 00 0 CAM0 00

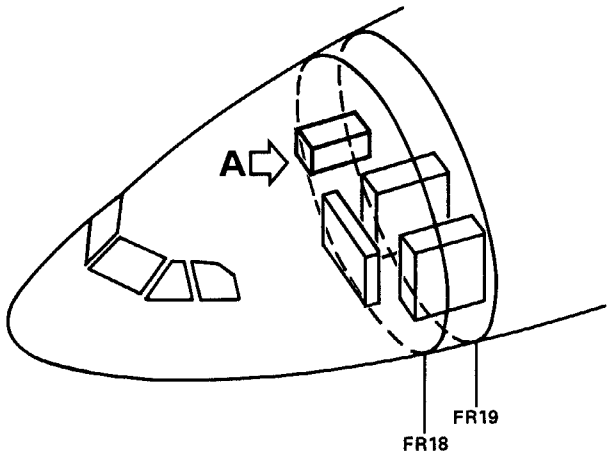
TCAS - Antennas Location
Figure 003

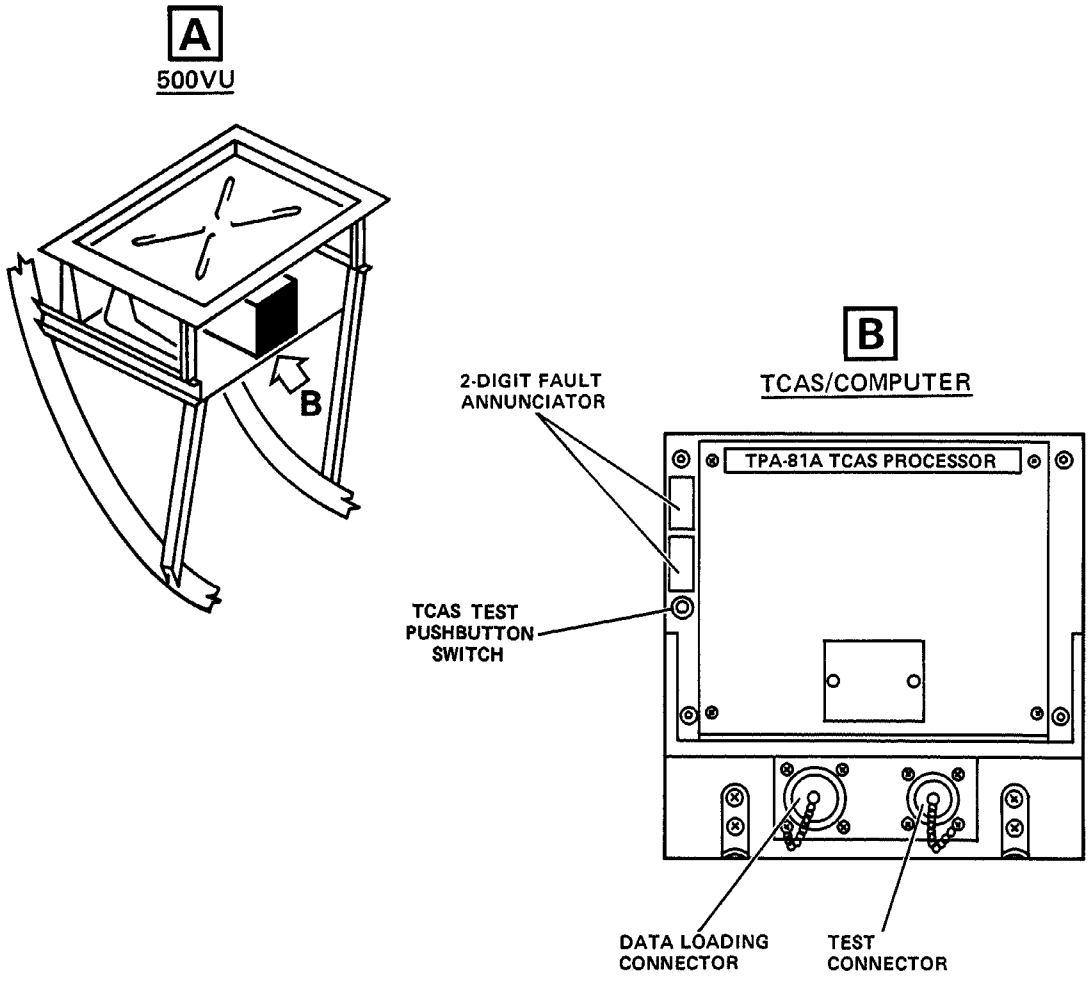


BM5 34 44 00 0 CGM0 00

TCAS - Antennas Location
Figure 004

R





BM5 34 44 00 0 CCM0-00

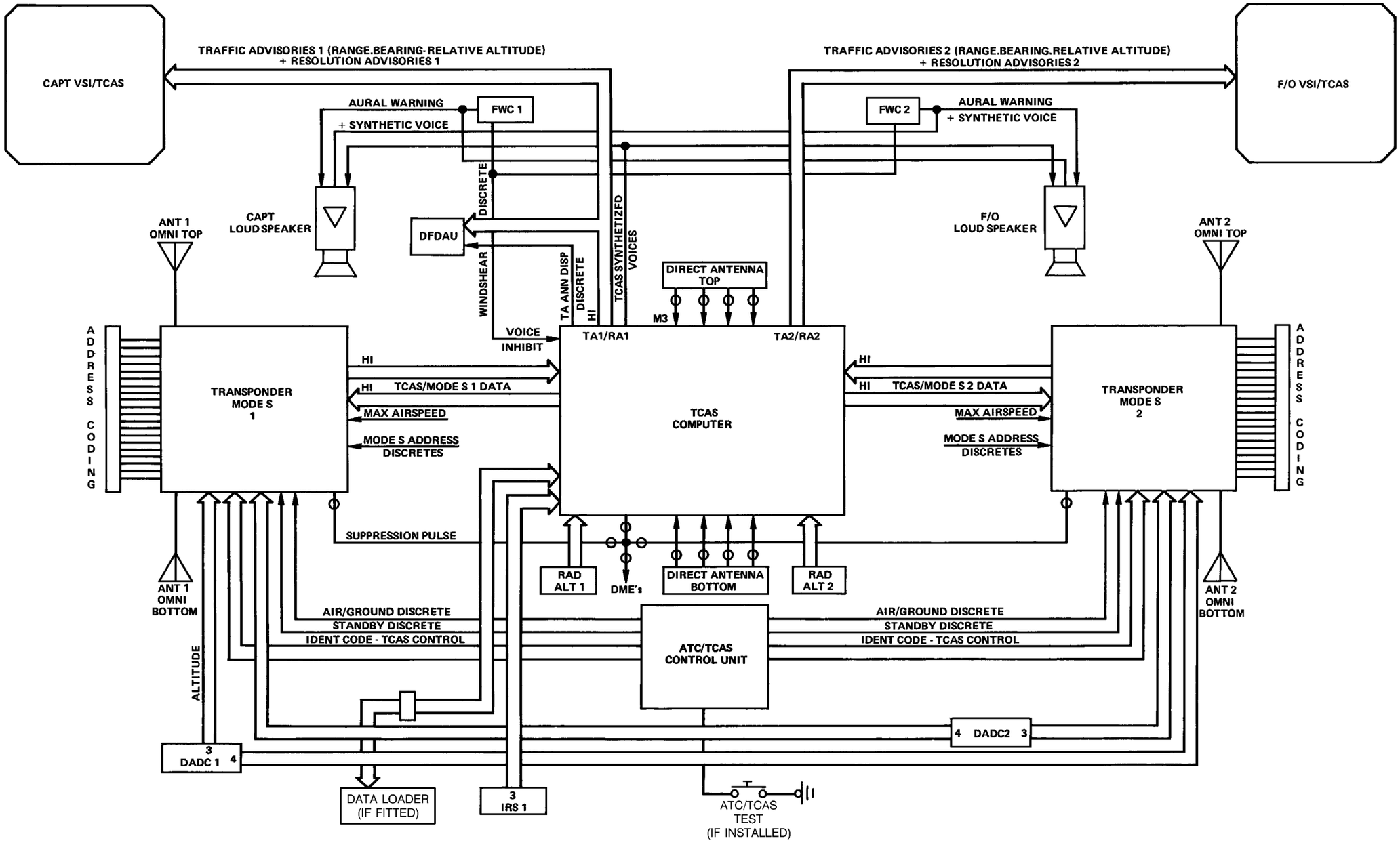
TCAS - Computer Location
Figure 005

3. System Description
(Ref. Fig. 006)

A. Principle
When a TCAS-equipped aircraft is airborne, its TCAS periodically transmits interrogation signals for all ATCRBS and Mode S transponder-equipped aircraft in the vicinity. These interrogations are received by the ATCRBS ground stations and by the transponders of the other aircraft.
In response to these interrogations, the transponders of nearby aircraft return signals containing their altitude value. The TCAS computes the range between the two aircraft by measuring the elapsed time between transmission of the interrogation and reception of the reply.
The altitude, altitude rate, range and range rate are determined by a periodic tracking of these exchanges and the data are used for intruder threat assessment.
Each threat is treated individually but the TCAS determines the best collision avoidance possibility with respect to all aircraft in its vicinity, while establishing maneuver coordination with the other TCAS-equipped aircraft. The optimum maneuver is the one that ensures an adequate separation of trajectories with a minimum vertical trend variation.

B. Advisories
Visual and aural advisories are supplied by the TCAS computer whenever assessment of the relative position of two aircraft reveals a potential collision hazard.
The Traffic Advisories indicate the position of nearby aircraft which are or may become a threat. Their display on the indicator alerts the flight crew to the presence of intruders and facilitates their visual acquisition.
The Resolution Advisories may be divided into two categories :
- Corrective Advisories that instruct the pilot to deviate from current vertical rate
- Preventive Advisories that instruct the pilot to avoid certain maneuvers.

C. Display
The VSI/TCAS indicator is a color liquid crystal display that permits display of conventional vertical speed information and at the same time, intruder location and avoidance maneuver indications.
The indicator displays a traffic area around the aircraft symbol and appropriate avoidance orders on the vertical speed band, by means of green and red arcs indicating the permitted vertical speed to be adopted.
Intruders are represented by symbols positioned in range and relative bearing with respect to the aircraft symbol. A data tag and vertical trend arrow associated with each intruder symbol indicates the intruder's relative altitude and vertical trend.



BM5 34 44 00 0 ADP0 01

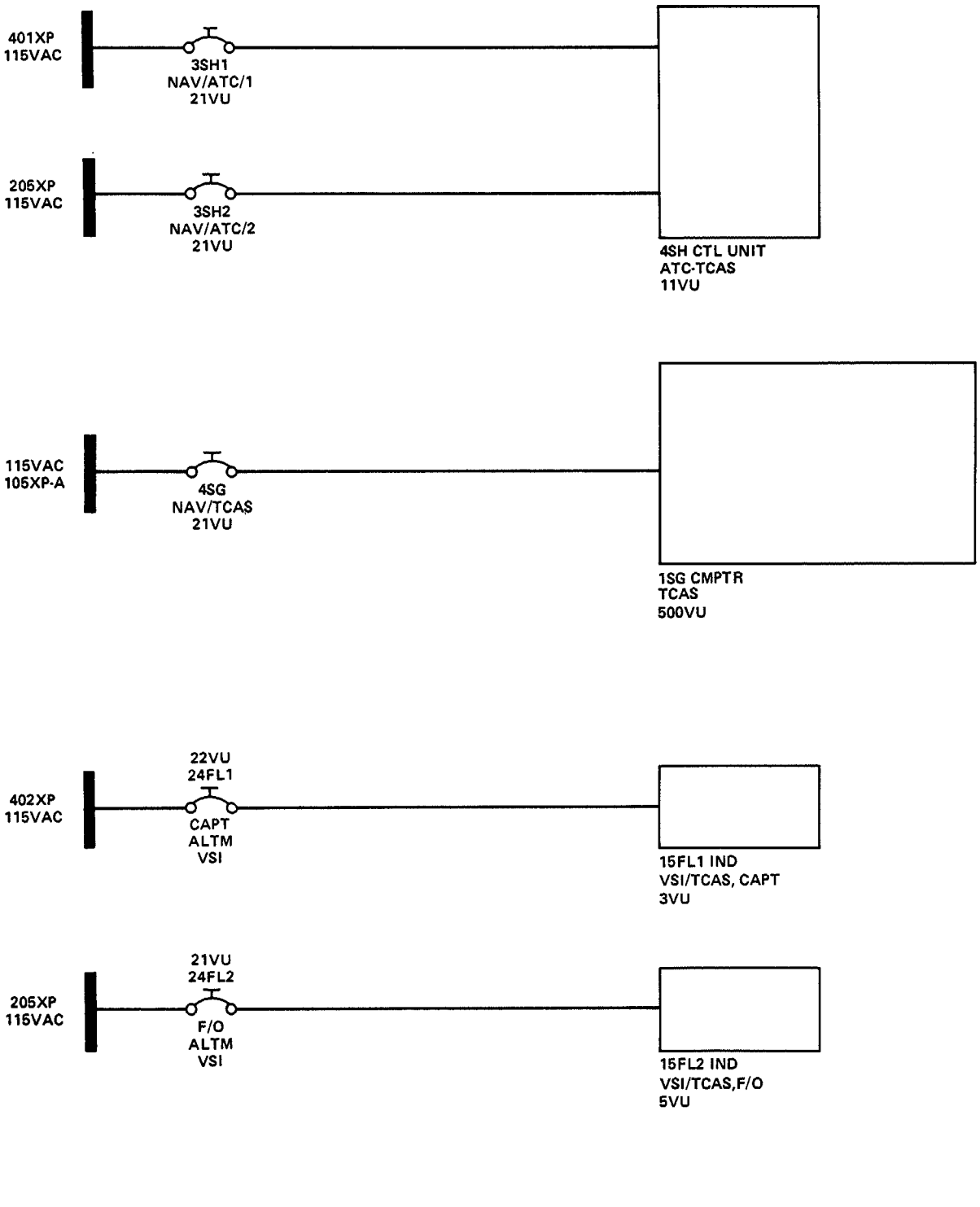
TCAS - Block Diagram
Figure 006

D. Coordination

The avoidance maneuvers initiated by the TCAS could create a conflict situation if directed at another TCAS-equipped aircraft as this aircraft may also take similar evasive action, resulting in an unchanged situation. To avoid this situation, a communication link between the two aircraft is established via the transponders, exchanging coordination messages. The first aircraft to detect the other one initiates the communication procedure, indicates the maneuvers it intends to perform and communicates orders to the other aircraft requesting it to maintain its trajectory. This necessarily involves the use of Mode S transponders, the only equipment of this type possessing the LINK function required for data exchange. The Mode S transponders provide the capability to transmit a unique address assigned to each aircraft, permitting them to reply individually to other TCAS-equipped aircraft. It can respond to ground station interrogations in Mode A and Mode C and also in Mode S if the stations are suitably equipped. With respect to aircraft equipped with Mode A transponders only, the TCAS cannot generate resolution advisories as these transponders do not communicate aircraft altitude. The aircraft are however displayed on the VSI/TCAS indicator, enabling their location in range and bearing, but with no altitude indications.
The ground stations can modify the TCAS operating mode via the transponder link so as to inhibit resolution advisories in certain conditions.

E. Power Supply

The TCAS is supplied with 115VAC, 400 Hz. The ATC/TCAS control unit, common to the ATC transponders and the TCAS computer, is also supplied with 115VAC :
The Captain and First Officier VSI/TCAS indicators are independently supplied with 115VAC.
(Ref. Fig. 007)



TCAS - Power Supply
Figure 007

R EFFECTIVITY: 005-200,

PIA

4. Component Description

A. TCAS Computer

(1)Description

The TCAS computer is a tray-mounted (6 MCU) ARINC 735 assembly. It contains a microprocessor-based central TCAS control unit and an L-band RF transmitter receiver.

The face features :

- two windows on the upper left side, to display a code identifying the failed equipment
- a pushbutton switch below the two windows, to trigger the self-test
- two connectors at the bottom, one for the data loading, and the other for the test equipment
- a handle.

Interface connectors (ARINC 600) are installed on the back.

(Ref. Fig. 008)

(2)Operation

The TCAS computer features two main functions :

- a radio-electric transmission reception function in the L-band frequency for intruder acquisition
- a processing function ensuring total operation control : digital, discrete and analog-type interfaces, intruder trajectory computation and tracking, visual and aural alert commands.

The computer is divided into four major sections :

- Radio Frequency section (RF)
- Video Processor (VP)
- Data Processor (DP)
- Input/Output Processor (IOP).

(Ref. Fig. 009)

(a)Radio frequency section (RF) :

The RF section consists of receiver, transmitter and RF switch portions.

The receiver processes the raw ATCRBS or Mode S intruder reply data received from either the top or bottom antenna. The transmitter portion of the RF section interrogates intruders, also using either antenna. The RF switch portion selects the antenna (top or bottom) for the transmission and reception of the TCAS signals.

(b)Video Processor (VP)

The video processor contains circuitry needed to perform the following functions :

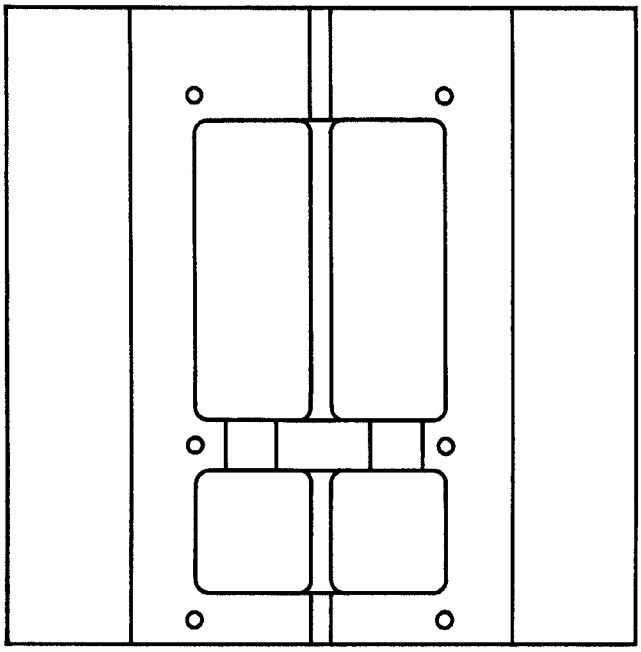
- analog-to-digital conversion
- quantization of the video inputs
- decoding of ATCRBS Mode A and Mode C replies and elimination of phantom replies
- Mode S and address decoding and error detection/correction
- storing of bearing information.

The video controller generates outputs as required for control of the transmitter, antenna switches and receiver.

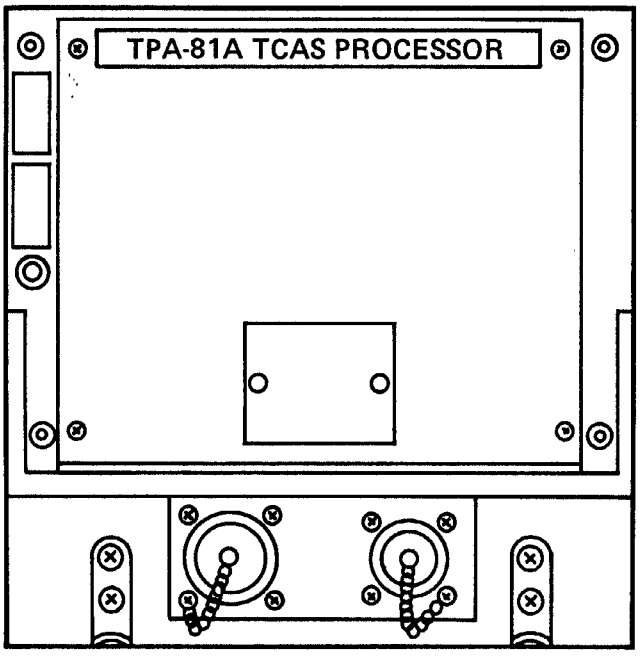
(c)Data Processor (DP)

The data processor module processes the data input from the video processor and input/output circuits. It also operates the links between

BACK

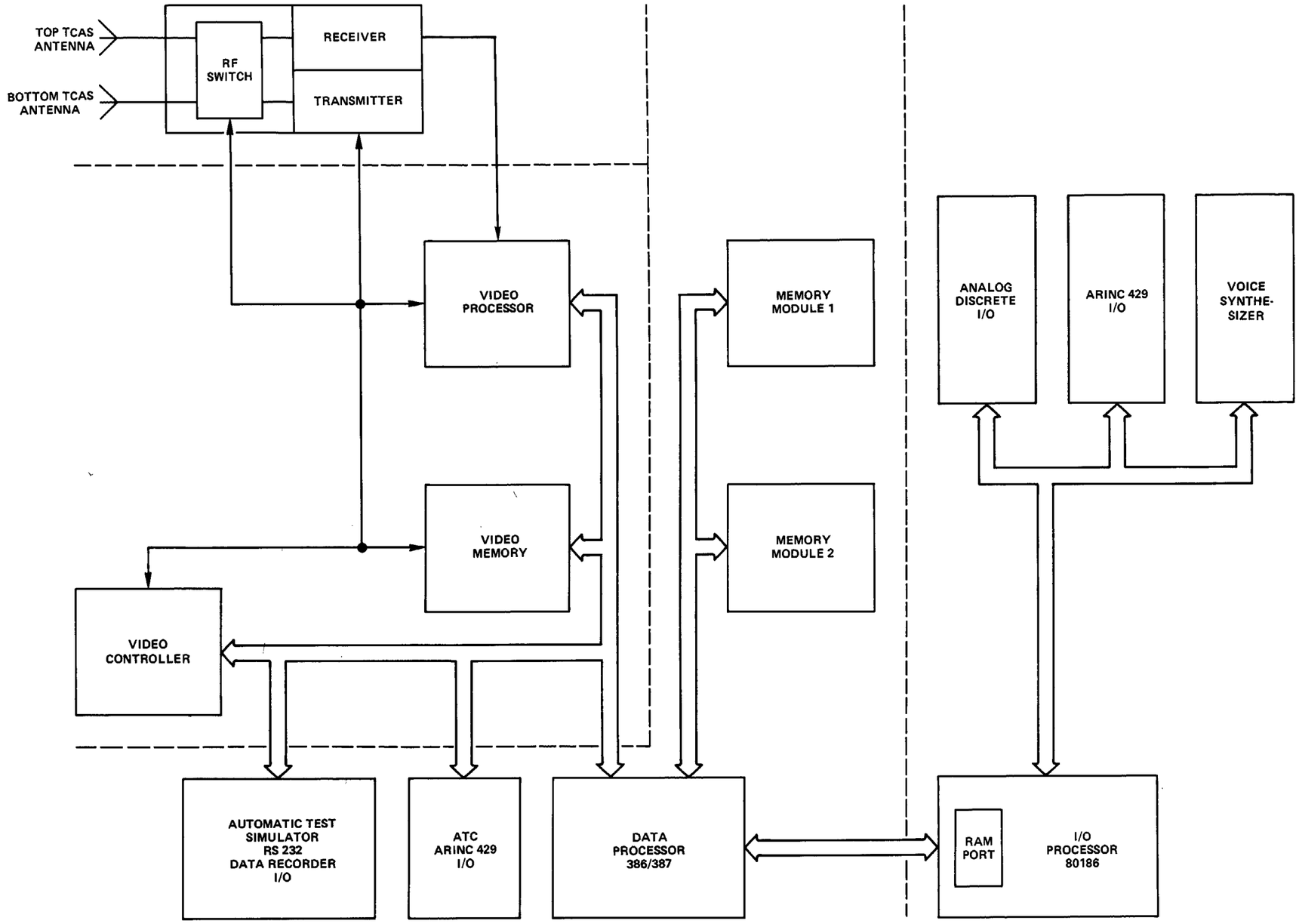


FACE



BM5 34 44 00 0 CDM0 -00

TCAS - Computer
Figure 008



TCAS Computer - Simplified Block Diagram
Figure 009

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BMD 34 44 UU U BUMU-U1

the associated transponders and supplies the connector, reserved for the data recorder, mounted on the computer's front panel, via the interface circuits.
The data processor module provides the computational capabilities required for processing the TCAS functions.

(d)Input/Output Processor (IOP)
The IOP module provides the main interface between the data processor and external hardware. It acquires most of the aircraft data used by the TCAS and transmits control and information signals to the other equipment.
The data is composed of discrete inputs/outputs, program pins and ARINC 429 data except those of the transponder, acquired directly by the data processor. This module also contains the synthesized voice message generation and possess the capability to process analog signals for non-digital aircraft. A validity check is performed on ARINC 429 input data.
An audio output channel (low level) allows connection to both the flight compartment loudspeakers.

B. ATC/TCAS Control Unit
The ATC/TCAS control unit, common to the ATC transponders and the TCAS computer, enables the operating modes of these two items of equipment to be selected. Information intended for the TCAS is transmitted via an ARINC 429 bus to the transponders which in turn transmit it to the TCAS computer.

**ON A/C 005-100,

(Ref. Fig. 010)

**ON A/C 101-200,

(Ref. Fig. 011)

R **ON A/C 005-100,

(1)TCAS modes of operation
The TCAS mode of operation is selected by means of a switch with three positions "STBY, TA, TA/RA".

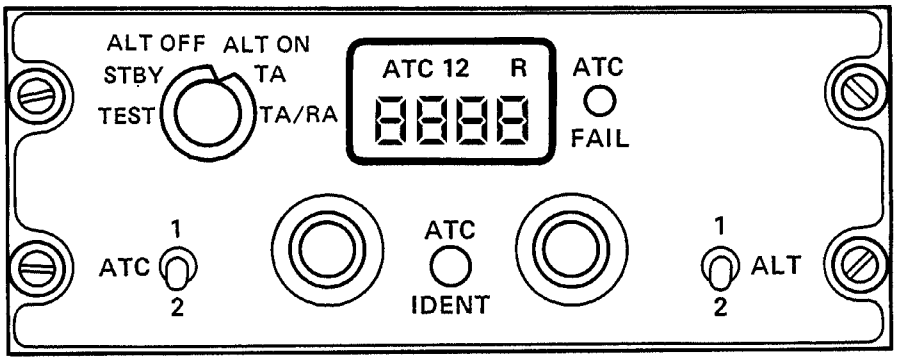
(a)STBY mode
In the Standby Mode, the advisory generation and surveillance functions are inhibited. No TCAS information can be displayed on the VSI/TCAS indicator.

R The aircraft symbol and the range ring disappear and vertical speed information is displayed normally. The white TCAS OFF flag is displayed in the center right.

R (Ref. Fig. 012)

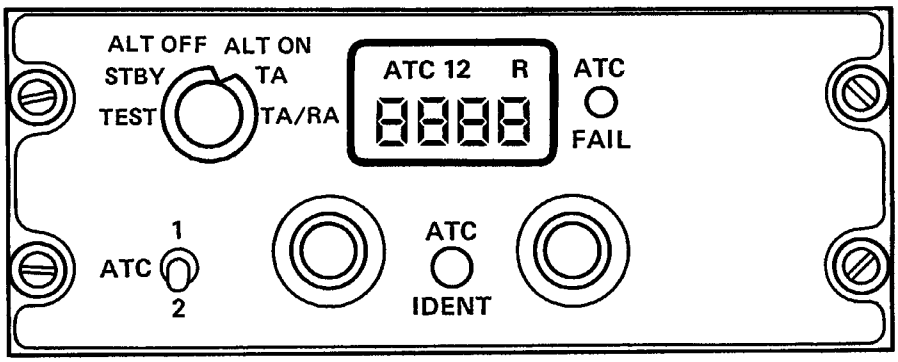
(b)TA mode
In this mode, intruders are displayed on the indicator according to their position in the airspace. The RA type intruder symbols are converted into TA type symbols. The TCAS performs surveillance functions but does not generate any resolution advisories.

R The VSI/TCAS indicator displays the yellow TA ONLY flag in the bottom



BM5 34 44 00 0 AZN0-00

TCAS - ATC/TCAS Control Unit
Figure 010



BM5 34 44 00 0 AZP0 00

TCAS - ATC/TCAS Control Unit
Figure 011

right corner.

R (Ref. Fig. 013)

(c)TA/RA mode

The TCAS performs all TA mode functions and also issues preventive or corrective resolution advisories, represented in the form of colored arcs along the vertical speed scale.

The sensitivity level is determined automatically in function of altitude.

NOTE : The final mode of operation is a combination taking into account the aircraft altitude and any instructions received from ground stations.

R (Ref. Fig. 014)

(2)Altitude reporting

This function is activated by a switch with two positions.

(a)OFF position

R Selection of the ALT RPTG switch to OFF position has the following results :

- the TCAS switches to the standby mode
- the VSI/TCAS indicator display corresponds to the standby mode and the TCAS FAIL flag is displayed in the center right
- the Mode S transponder continues to transmit squitters and reply to interrogations but does not report altitude.

(b)ALT RPTG position

The active transponder replies to interrogations and reports its altitude. The TCAS operates in the mode selected by its logic in function of information input from the control unit, ATCRBS/MODE S ground stations and in function of aircraft altitude.

(3)ATC SYS 1/2 switch

This permits selection of the active transponder. The non-selected transponder is placed in standby mode.

(4)Identification code in Mode A

The Mode S transponder also replies to Mode A interrogations from ground stations. Two pairs of concentric knobs permit the pilot to set the Mode A code assigned to the aircraft by a ground station and included in the transmitted replies. A window on the control unit displays this code permanently.

(5)IDENT pushbutton switch

On ground station request, an addition pulse must be included in the Mode A and Mode C replies transmitted by the transponder to enable a more precise location. This operation is performed by pressing the IDENT pushbutton switch on the control unit.

(6)ATC FAIL light

This amber light comes on when a failure is detected in the active ATC Mode S transponder.

(7)ATC mode of operation

The mode of operation of the transponder is selected by a switch with three positions "STBY, AUTO, ON".

(a)STBY mode

When the transponder is in standby it does not transmit either squitters or repliers to ground station or other aircraft interrogations.

(b)Auto mode

In flight, the aircraft operates as in the **ON** mode : all its functions are active.

When the aircraft touches down, the landing gear ground/flight relay disables the Mode **A** and **C** replies of the selected transponder from ground station interrogations.

However the Mode **S** replies and squitter are not inhibited when the **A/C** is on the ground.

(c)**ON** mode

The Mode **S** transponder operates permanently, both in flight and on the ground. It periodically transmits squitters (at 1 second intervals) to be detected by other aircraft and replies to their interrogations and those from ground stations.

R **ON A/C 101-200,

(1)TCAS modes of operation
The TCAS mode of operation is selected by means of a rotary switch with six positions but only four positions correspond to a TCAS mode : "STBY, TA, TA/RA, TEST".

(a)STBY mode
In the Standby Mode, the advisory generation and surveillance functions are inhibited. No TCAS information can be displayed on the VSI/TCAS indicator.
The aircraft symbol and the range ring disappear and vertical speed information is displayed normally. The white TCAS OFF flag is displayed in the center right.
(Ref. Fig. 012)

(b)TA mode
In this mode, intruders are displayed on the indicator according to their position in the airspace. The RA type intruder symbols are converted into TA type symbols. The TCAS performs surveillance functions but does not generate any resolution advisories.
The VSI/TCAS indicator displays the yellow TA ONLY flag in the bottom right corner.
(Ref. Fig. 013)

(c)TA/RA mode
The TCAS performs all TA mode functions and also issues preventive or corrective resolution advisories, represented in the form of colored arcs along the vertical speed scale.
The sensitivity level is determined automatically in function of altitude.
NOTE : The final mode of operation is a combination taking into account the aircraft altitude and any instructions received from ground stations.
(Ref. Fig. 014)

(d)TEST Mode
In the TEST mode, the self-test of the TCAS computer and ATC Mode S transponders is initialized. TCAS flag is displayed on the center right of both VSI/TCAS indicators during all the self-test, approximately five seconds.
In a first time, a preventive advisory is displayed on VSI/TCAS indicators. In a second time, the TCAS COMPUTER SOFTWARE P/N message appears in the upper part of the VSI/TCAS indicators. And in a third time, the result of test appears : OK or FAIL message is displayed in front of each component of TCAS system.

(2)Altitude reporting
The two last positions of the rotary switch activate this function.

(a)ALT OFF mode
ATC Mode S transponders are fully active and TCAS computer is in STBY mode :
- on both VSI/TCAS indicators, the traffic display is blanked and the TCAS FAIL flag is displayed on the center right
- the ATC Mode S transponders continue to transmit squitters and reply

to interrogations but do not report altitude.

(b)ALT ON mode

The active ATC Mode S transponder replies to interrogations and reports its altitude in addition to the functions performed by the ALT OFF mode.

(3)ATC 1/2 switch

This permits selection of the active transponder. The non-selected transponder is placed in standby mode.

(4)Identification code in Mode A

The Mode S transponder also replies to Mode A interrogations from ground stations. Two pairs of concentric knobs permit the pilot to set the Mode A code assigned to the aircraft by a ground station and included in the transmitted replies. A window on the control unit displays this code permanently.

(5)ATC IDENT pushbutton switch

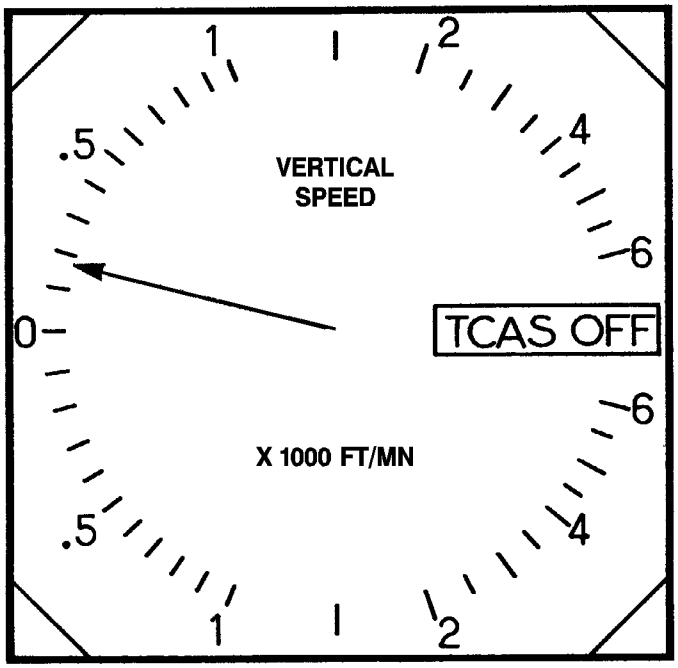
On ground station request, an addition pulse must be included in the Mode A and Mode C replies transmitted by the transponder to enable a more precise location. This operation is performed by pressing the ATC IDENT pushbutton switch on the control unit.

(6)ATC FAIL light

This amber light comes on when a failure is detected in the active ATC Mode S transponder.

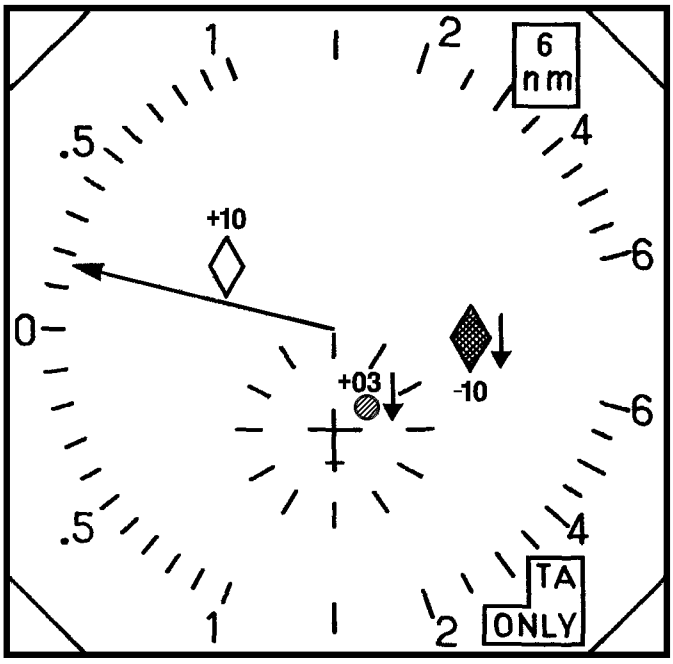
(7)ALT 1/2 switch

It allows selection of one of two altitude source input ports.



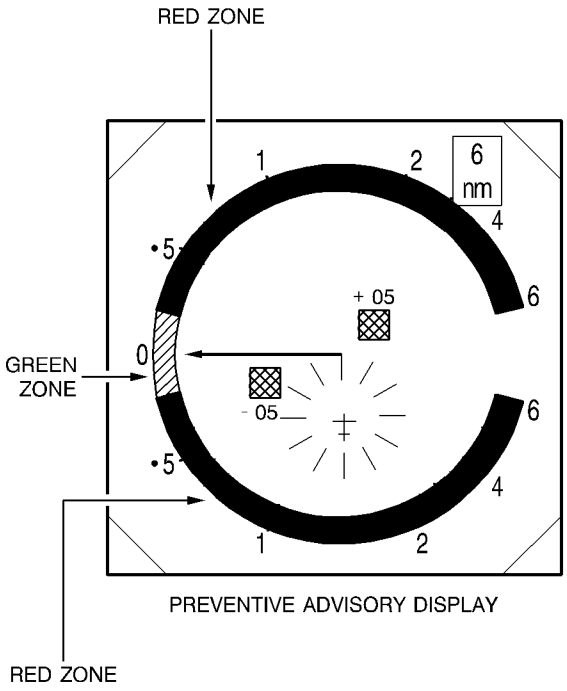
BM5 34 44 00 0 BAM0 01

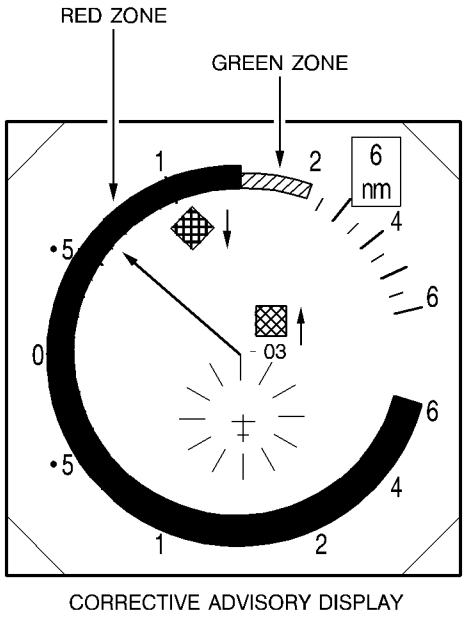
TCAS - STBY Mode Display
Figure 012



BM5 34 44 00 0 BBM0 01

TCAS - TA Mode Display
Figure 013





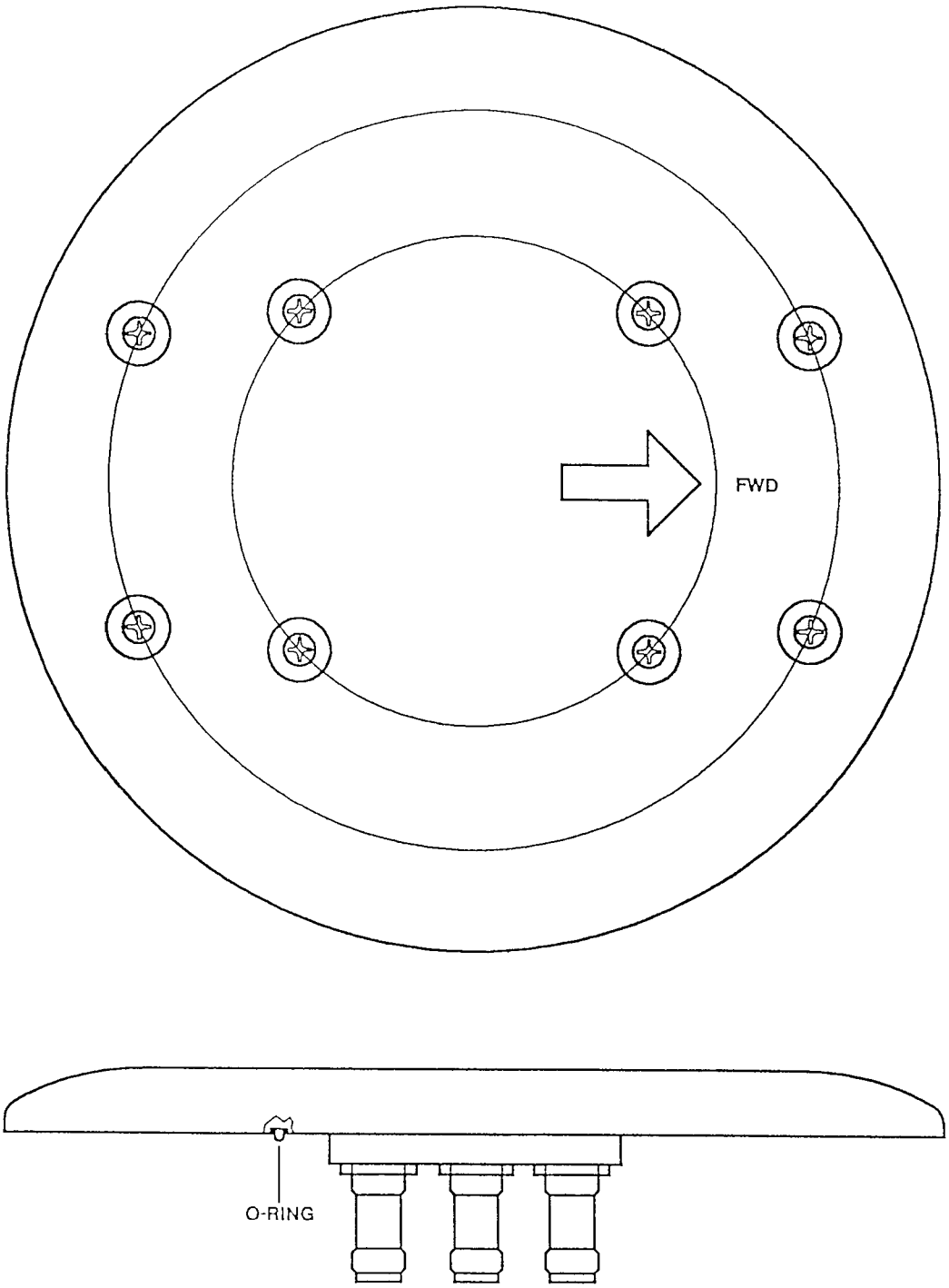
BM5 34 44 00 0 AXM0 00

TCAS - TA/RA Mode Display
Figure 014

R **ON A/C 005-200,

C. Antennas
The TCAS has two antennas. These antennas (transmit/receive type), provide azimuth information on aircraft located within the TCAS surveillance range. They consist of four independent elements. In reception, the phase and amplitude of the signals received by each element depend on the direction of the signal source, which permits the relative bearing of the transmitting aircraft to be determined.
(Ref. Fig. 015)

D. VSI/TCAS Indicators
Advisories are displayed on the VSI/TCAS indicators by high speed transmission of ARINC 429 messages on the buses linking the TCAS to the Captain and First Officer VSI/TCAS indicators.
The VSI/TCAS indicators provide indications on the location of intruders in the traffic area, the trajectory modification orders and the flags and messages.
(1)Traffic display
(a)Symbology
Target aircraft present in the surveillance zone and detected by the TCAS are depicted by symbols on the VSI/TCAS indicator.
The number of displayed targets is limited to eight by pin programming at the TCAS computer connector.
The own aircraft is depicted by an aircraft symbol offset towards the bottom center of the display. The scale of the display is such as to show 6.5 NM ahead and 2.5 NM behind own aircraft symbol.
A white range ring with markings at each of the twelve clock positions is placed around the own aircraft symbol at a radius of 2 NM.
The shape of the traffic symbols corresponds to the threat level they represent and a data tag and vertical trend arrow associated with each target indicate its relative altitude and vertical trend.
Targets are symbolized according to their type :
- OTHER TRAFFIC : cyan diamond, outline only, height and width 3.36 mm
- PROXIMATE TRAFFIC : cyan filled diamond, height and width 3.36 mm
- TRAFFIC ADVISORY : amber/yellow filled circle, diameter 2.88 mm
- RESOLUTION ADVISORY : red filled square, side 2.88 mm.
The traffic symbols are positioned with respect to the own aircraft symbol so as to depict their relative bearing and range to the TCAS-equipped aircraft.



BM5 34 44 00 0 AAL0 00

TCAS - Antenna
Figure 015

E. ATC Mode S Transponders
Two Mode S transponders, one active and the other in standby, are used with their antennas. Each transponder is linked to the TCAS by one high-speed ARINC 429 bus for transmission and another one for reception.
Apart from the specific transponder functions (response to ATC ground station interrogations, diversity antenna and selective calling) they permit communication between the TCAS and a TCAS-equipped detected aircraft.

F. Peripherals

**ON A/C 101-200,

(Ref. Fig. 016)

**ON A/C 005-100,

(Ref. Fig. 017)

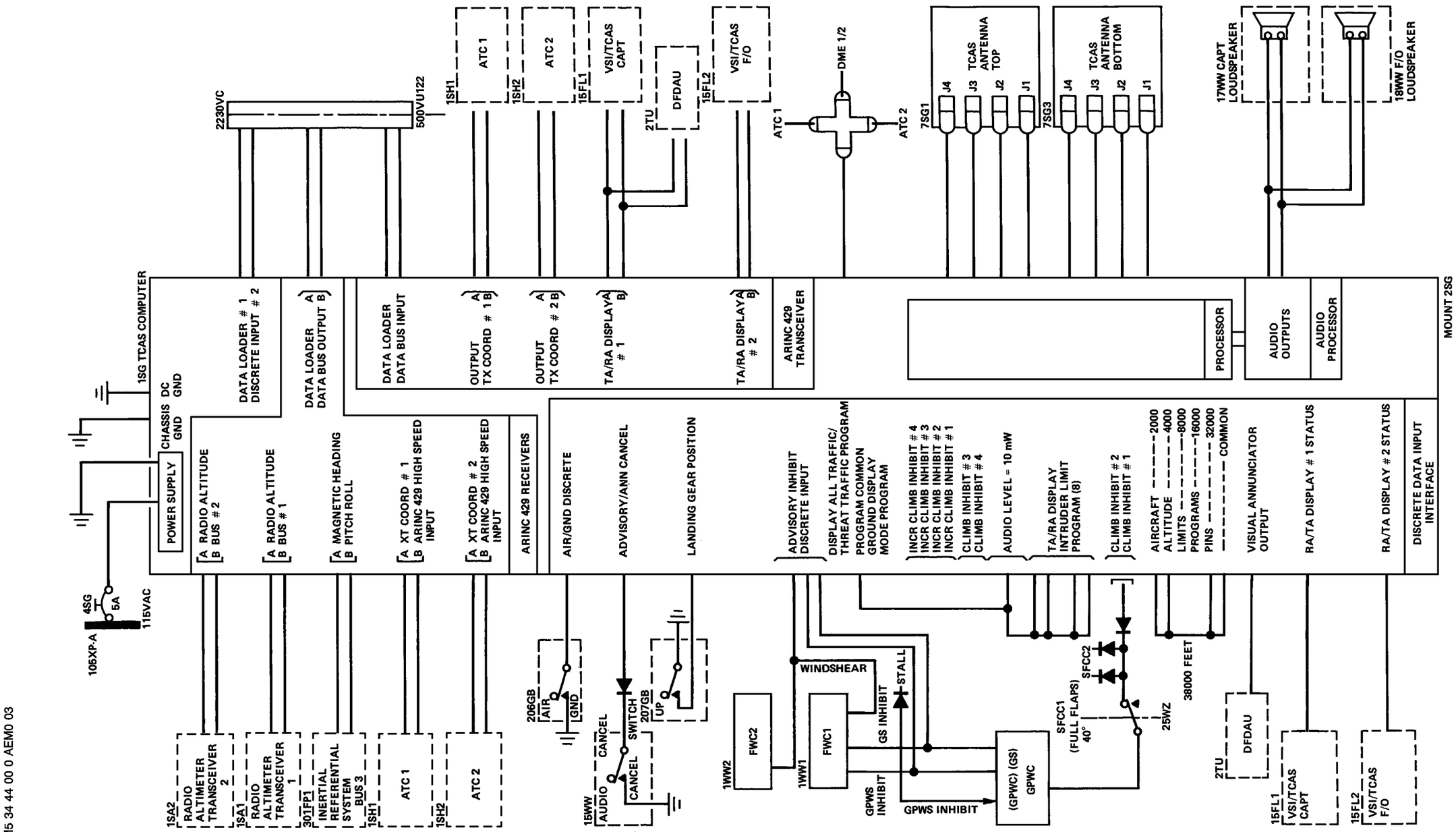
**ON A/C 005-200,

(1)The TCAS receives information from the following equipment :
(a)Radio altimeter
The radio altitude is an essential parameter for the TCAS. In the 0 to 2500 ft range it permits modulation of system sensitivity and triggering of inhibit orders. For this reason, two radio altimeters, one active and the other in standby, are linked to the TCAS via the low speed ARINC 429 bus.
(b)Air data system
Barometric altitude information fulfils the same functions as radio altitude information but for the range over 2500 ft. The DADC, which is not directly linked to the TCAS computer, transmits this information to the computer via the transponders across the ARINC 429 buses.
(c)Inertial reference system
The TCAS is linked by a high speed ARINC 429 bus to the aircraft IRS 1 which supplies it with magnetic heading and pitch and roll attitude information.
(d)DFDAU
The DFDAU picks up some parameters through the TCAS bus which supplies the Captain VSI/TCAS indicator.
In addition TA annunciator display discrete output is directly linked to the DFDAU.
According to the FAA regulations the following parameters have to be recorded :
- RA via label 270
- TA via TA annunciator display discrete
- manual sensitivity level via label 016.

**ON A/C 101-200,

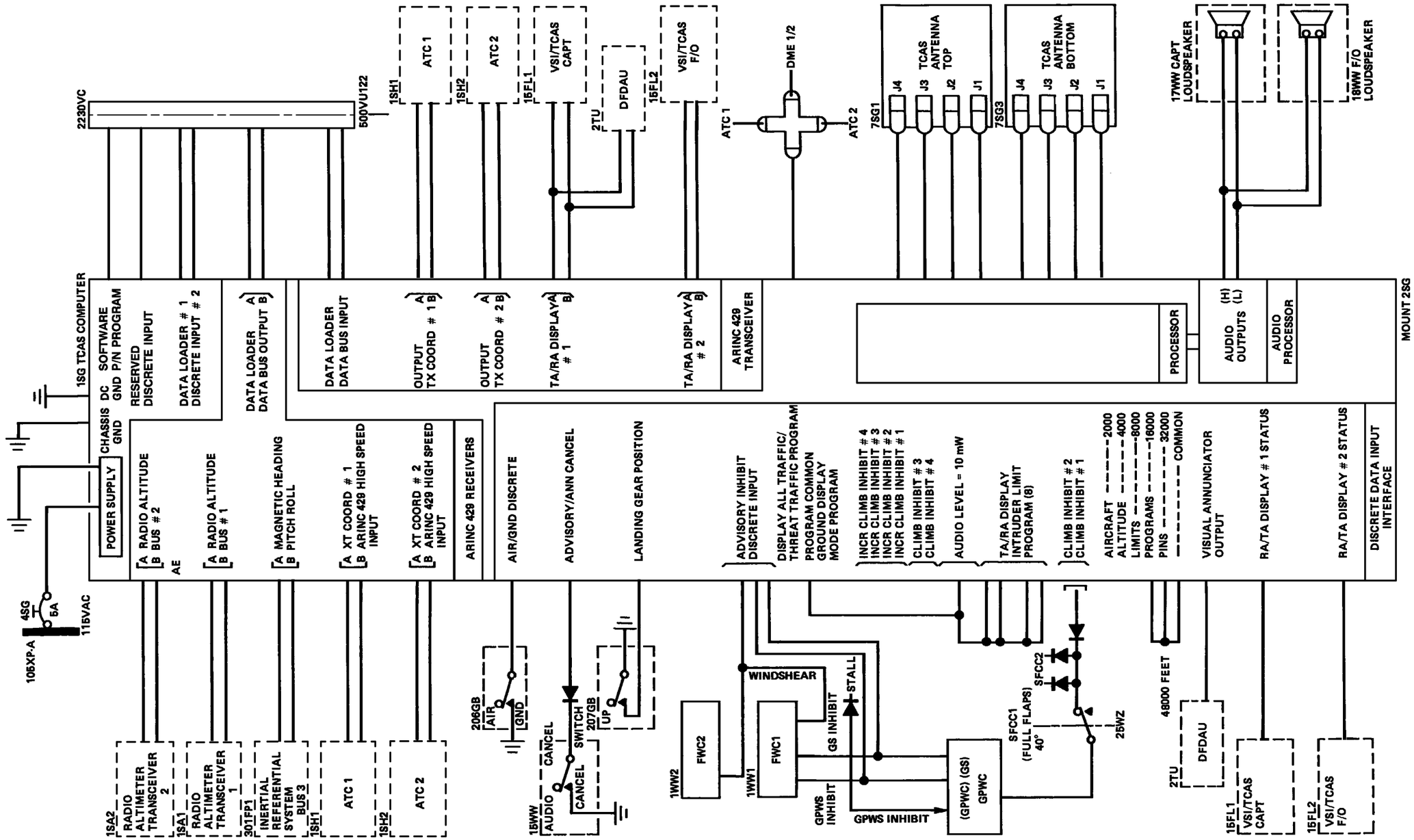
(5)Various discrete signals

INTENTIONALLY BLANK



BM5 34 44 00 0 AEM0 03

TCAS - Schematic
Figure 016



BM5 34 44 00 0 AEN0 01

TCAS - Schematic
Figure 017

Discretes are used for the inhibition of certain advisories by equipment with higher priority than the TCAS :
- advisory inhibit by the windshear signal from the FWCs
- advisory inhibit by the stall warning
- advisory inhibits by the following signals from the GPWS :
  . GS (Glide Slope) (GPWC)
  . GPWC (GPWC).

A discrete input linked to the AUDIO/CANCEL switch commands inhibition of the Aural Advisories.
The VSI/TCAS indicators send status discretes to the TCAS computer which generates flags on the indicator via the ARINC 429 bus.
Particular operating conditions may also be activated by the following landing gear status discretes :
- ground/flight signal
- L/G extended signal.

(6)Pin programming

Discrete pin program inputs are used :
- audio level to set the audio level of the synthetic voice output
- DISPLAY ALL TRAFFIC/THREAT TRAFFIC PROGRAM indicates if all intruders are displayed or not
- ground display mode : specifies that the display mode, when the aircraft is on the ground, is the TA mode only
- display intruder limit : 8 intruders can be displayed
- aircraft altitude limit, configured at 38,000 ft informs the TCAS computer that it must inhibit climb orders above this altitude.

5. Operation

The TCAS periodically interrogates the transponders of the intruders, computes their trajectories and constantly determines their potential threat.
Their acquisition is achieved by means of two transmit/receive antennas.
The system can establish individualized communications with each aircraft through ATC/Mode S transponders, thus permitting operation in dense traffic areas while avoiding an overload of radio-electric transmissions that would result from a general all-intruder response.
The TCAS has the capability to communicate with ATCRBS (Air Traffic Control Radar Beacon System) ground stations equipped with the Mode S system to indicate to them the vertical maneuver orders presented to the aircraft pilot. This information can facilitate the task of the ground station controller who, in turn, can modify the TCAS operating mode and cancel the avoidance orders if he deems it necessary for safety.
The current surveillance envelope displayed on Vertical Speed Indicators covers an area of ± 2700 ft in altitude and 6 NM minimum in range.

**ON A/C 005-100,

(5)Various discrete signals

Discretes are used for the inhibition of certain advisories by equipment with higher priority than the TCAS :
- advisory inhibit by the windshear signal from the FWCs
- advisory inhibit by the stall warning
- advisory inhibits by the following signals from the GPWS :

. GS (Glide Slope) (GPWC)
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(6)Pin programming
Discrete pin program inputs are used :
- audio level to set the audio level of the synthetic voice output
- DISPLAY ALL TRAFFIC/THREAT TRAFFIC PROGRAM indicates if all intruders are displayed or not
- ground display mode : specifies that the display mode, when the aircraft is on the ground, is the TA mode only
- display intruder limit : 8 intruders can be displayed
- aircraft altitude limit, configured at 48,000 ft informs the TCAS computer that it must inhibit climb orders above this altitude.

5. Operation
The TCAS periodically interrogates the transponders of the intruders, computes their trajectories and constantly determines their potential threat. Their acquisition is achieved by means of two transmit/receive antennas.
The system can establish individualized communications with each aircraft through ATC/Mode S transponders, thus permitting operation in dense traffic areas while avoiding an overload of radio-electric transmissions that would result from a general all-intruder response.
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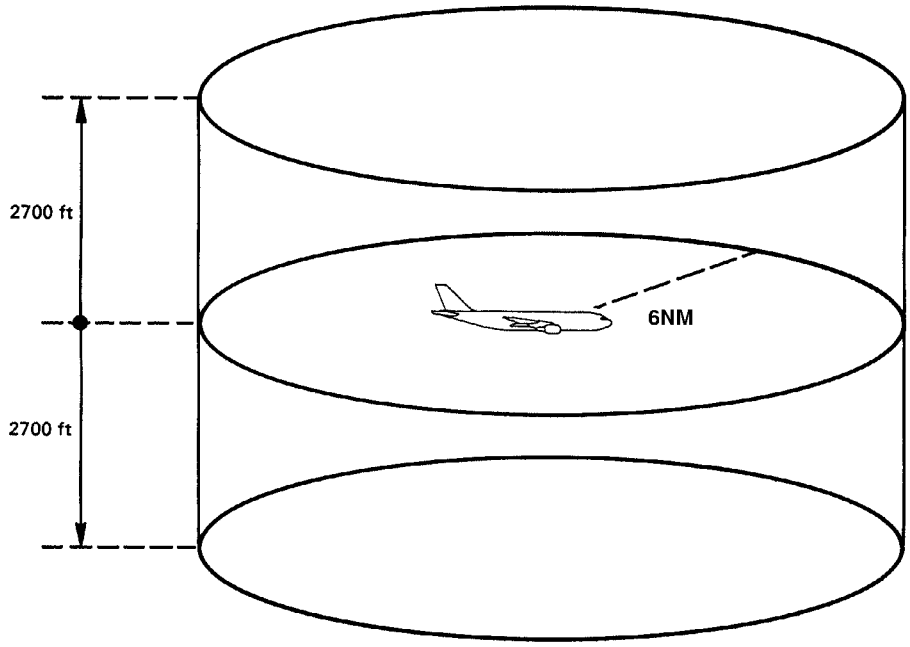
The current surveillance envelope displayed on Vertical Speed Indicators cover an area of ± 2700 ft in altitude and 6 NM minimum in range.

NOTE : For TCAS equipped with the ABOVE/BELOW function, the Vertical Speed Indicators can display up to ± 9900 ft in altitude (according to TCAS computer and ATC/TCAS control unit installed) and 14 NM in range.

**ON A/C 005-200,

(Ref. Fig. 018)

A. Intruder Detection
TCAS detects A/C equipped with Mode S transponders by listening for Mode S squitter transmissions. Mode S transponders announce their presence by transmitting squitter messages once every second. TCAS also detects A/C equipped with transponders that do not reply to Mode S interrogations but



BM5 34 44 00 0 AAM0 01

TCAS - Surveillance Envelope
Figure 018

do reply to Mode C interrogations. TCAS must actively search for Mode C equipped intruder aircraft because Mode C transponders do not transmit squitter messages. Once the presence of a Mode C intruder is confirmed, it is tracked by the TCAS. TCAS is capable of tracking up to a combined total of 30 Mode S and Mode C intruders.
Tracking is performed by repetitive TCAS interrogations in Mode S and Mode C format.

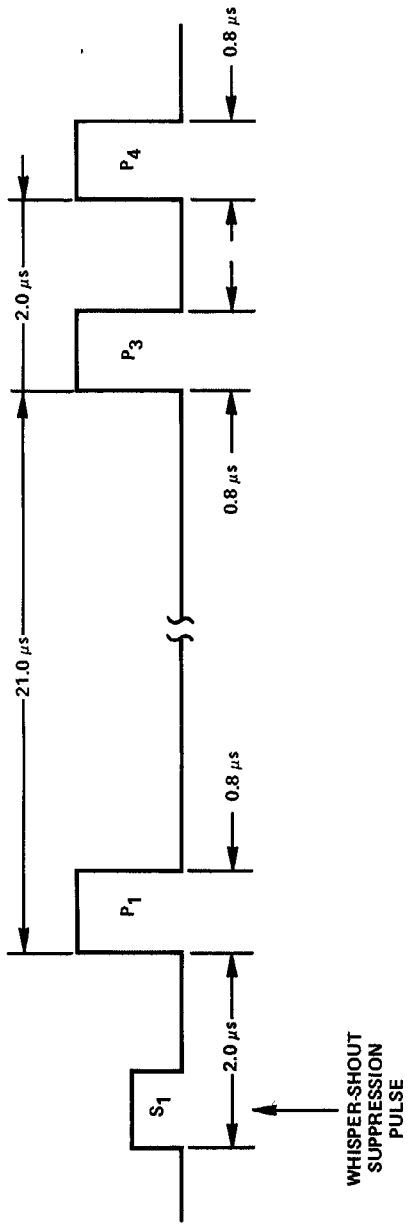
(1)Interrogation of aircraft equipped with Mode A or Mode C transponders
With respect to aircraft equipped with Mode A or Mode C transponders, the TCAS is active and transmits Mode C only all-call interrogations (P1, P3 and P4 pulses). The code is similar to the one used by the Mode A and Mode C ground stations. The P4 pulse informs those Mode S transponders that this interrogation is not addressed to them.
(Ref. Fig. 019)
The nominal time interval between two interrogations is one second. But, to limit radio-electric interference in dense traffic areas, each interrogation consists of a series of interrogations of increasing strength to reach more remote aircraft (whisper-shout) with 1 ms time periods inside the series.
The first transmission consists of relatively low power P1, P3 and P4 pulses only.
Therefore, only the nearest aircraft will receive and reply to these interrogations.
Then an S1 pulse is also transmitted. This pulse is at a lower amplitude, causing the close-in aircraft to interpret this as a side lobe from the transmitting station, requiring no reply. The purpose of the whisper-shout sequence is to reduce the number of aircraft replying to any one interrogation, thus limiting interference.

(2)Replies of A/C equipped with Mode A or Mode C transponders
Aircraft equipped with Mode C transponders reply by transmitting their altitude, octal encoded in four digits ABCD, with a value of 100 ft. for the LSB in the ATCRBS format.

R For aircraft of which the Mode A and C transponders do not have the
R altitude report, the intruder presentation on the VSI/TCAS indicator is
R limited to a display of its position in range and bearing.
R Aircraft equipped with Mode A transponders only cannot be detected by
R the TCAS.

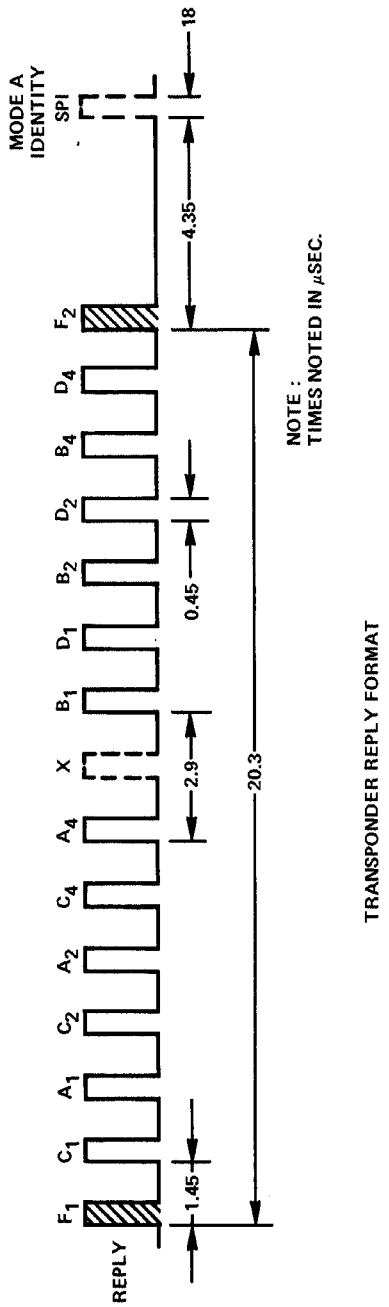
(Ref. Fig. 020)

(3)Interrogation of aircraft equipped with Mode S transponders
(a)Transmission coding
The TCAS uses the Mode S function for certain identification of intruders as a 24-bit address is definitively assigned to each aircraft by air traffic control.
The interrogation comprises three pulses : P1, P2 and P6. P2 level is equal to or greater than the P1 level, which is the no-reply condition for the aircraft equipped with Mode A or C transponders. Therefore, only Mode S transponders reply to the interrogation.
The useful information is contained in P6 divided into 56 or 112 chips. A chip is an unmodulated interval of 0.25 microseconds, preceded by possible phase reversals.
The message formats contain a number of bits permitting a more complete



BM5 34 44 00 0 AHM0 - 00

TCAS - Mode C Only All-Call Interrogation
Figure 019



BM5 34 44 00 0 AJM0 - 00

TCAS - Mode C Reply
Figure 020

and diversified information exchange than in Mode C.
There are two distinct message formats :
- all Mode S interrogations (UPLINK format) are binary differential phase shift keying (DPSK) signals
- Mode S replies (DOWNLINK format) are formed by pulse position modulation (PPM) encoding the reply data.

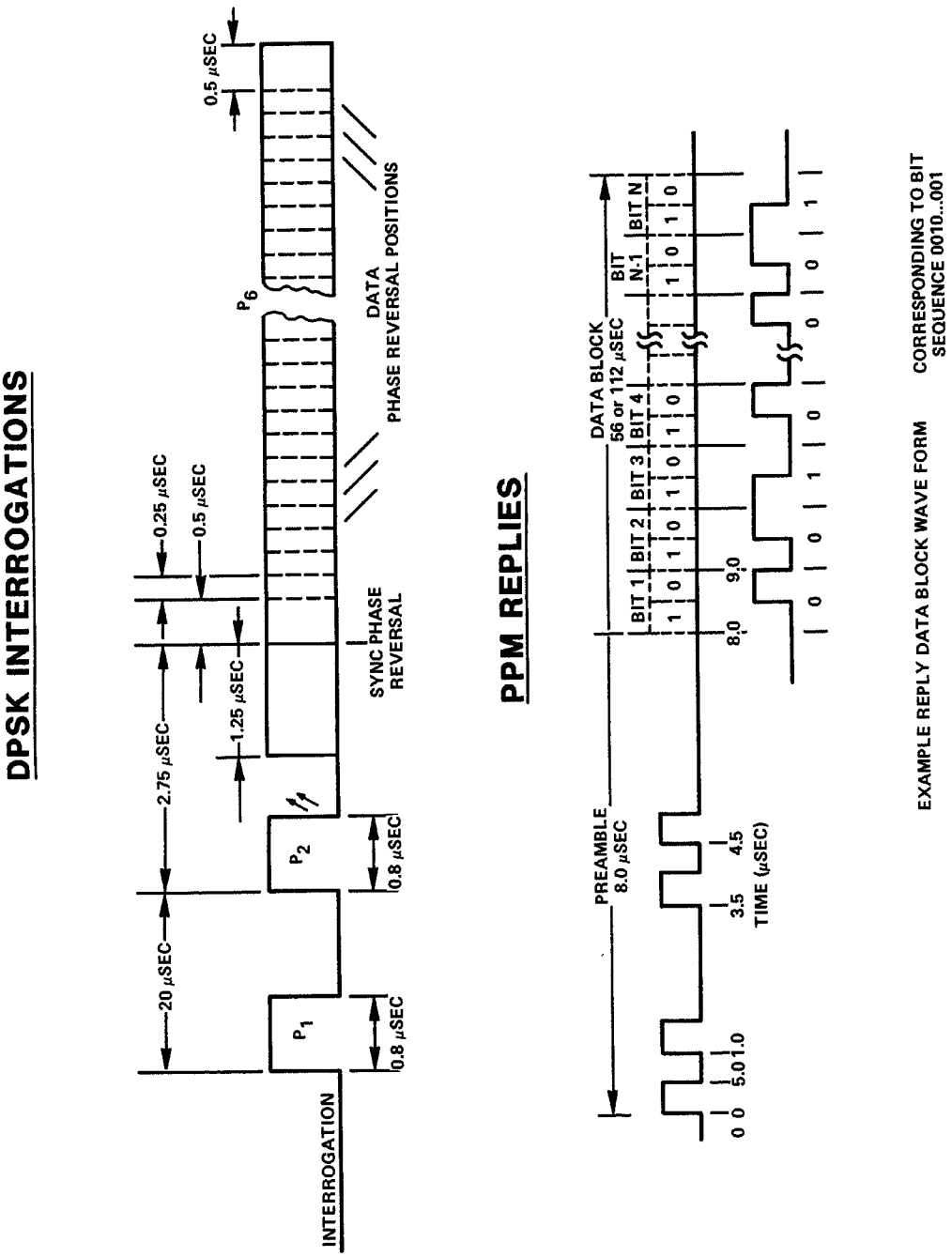
The Mode S reply is preceded by a preamble containing four pulses of specific duration and intervals intended to guarantee received message validity. Any messages whose preamble is not in complete conformity with the model are rejected by the TCAS. This information is encoded in PPM mode with, for each bit, a logic level one if the first half of the interval is at 1 and a logic level zero if it is at zero.
(Ref. Fig. 021)

(b)Squitters
The Mode S transponder participates actively in its own detection by transmitting signals, at one second intervals, intended to inform nearby aircraft of its presence.
This transmission, called squitter transmission, consists of a Format DF = 11 message, containing the Mode S 24-bit address assigned to the aircraft, whereas all the bits of the message PI field at zero indicates a squitter.

(c)Mode S communication messages
The Mode S ATC communications system supporting personalized exchanges between ATC ground stations and Mode S transponder-equipped aircraft comprises :
- a set of 25 standard messages for station-aircraft uplinks (Uplink format) identified UFxx
- another set of 25 standard messages for downlinks (Downlink format) identified DFxx.

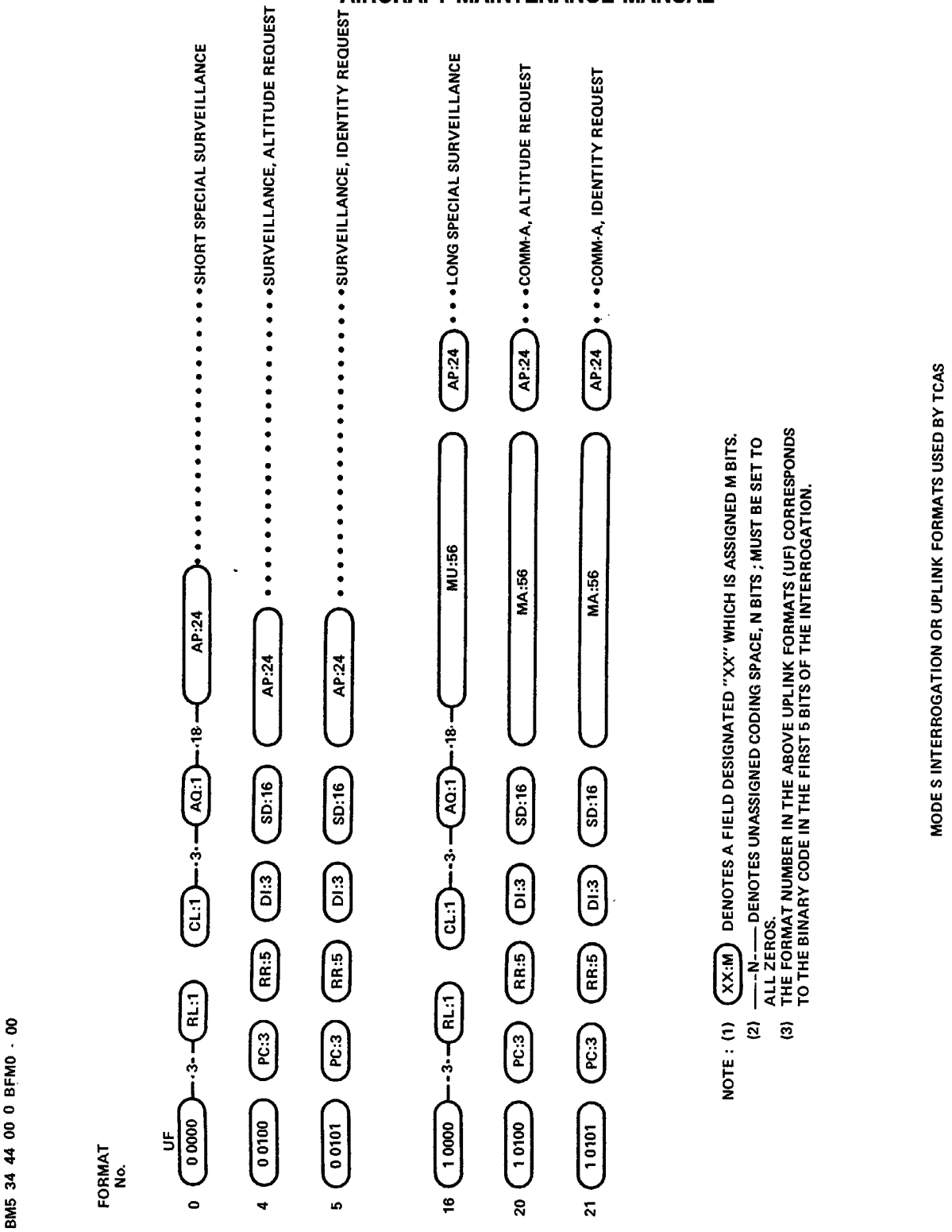
The message may be long or short and contain either 56 or 112 bits. Each message consists of specific fields with bit combinations that have specific meanings. Two fields, however, have an identical definition for all messages :
- the "message-type" field consisting of bits 1 to 5 whose coding translates the format decimal value into binary
- the address field containing the last 24 bits of the message (bits 33 to 56 or bits 89 to 112 depending on whether the message is short or long). These 24 bits contain the Mode S address of the transmitter.

The TCAS uses this bidirectional link capability to communicate with other TCAS-equipped aircraft to coordinate avoidance maneuvers. It may also dialog with ground stations : these stations have the possibility of monitoring and modifying its action.
In the Mode S message set, the TCAS uses only six UF-type (Uplink Format) messages and seven DF-type (Downlink Format) messages.
(Ref. Fig. 022)
(Ref. Fig. 023)

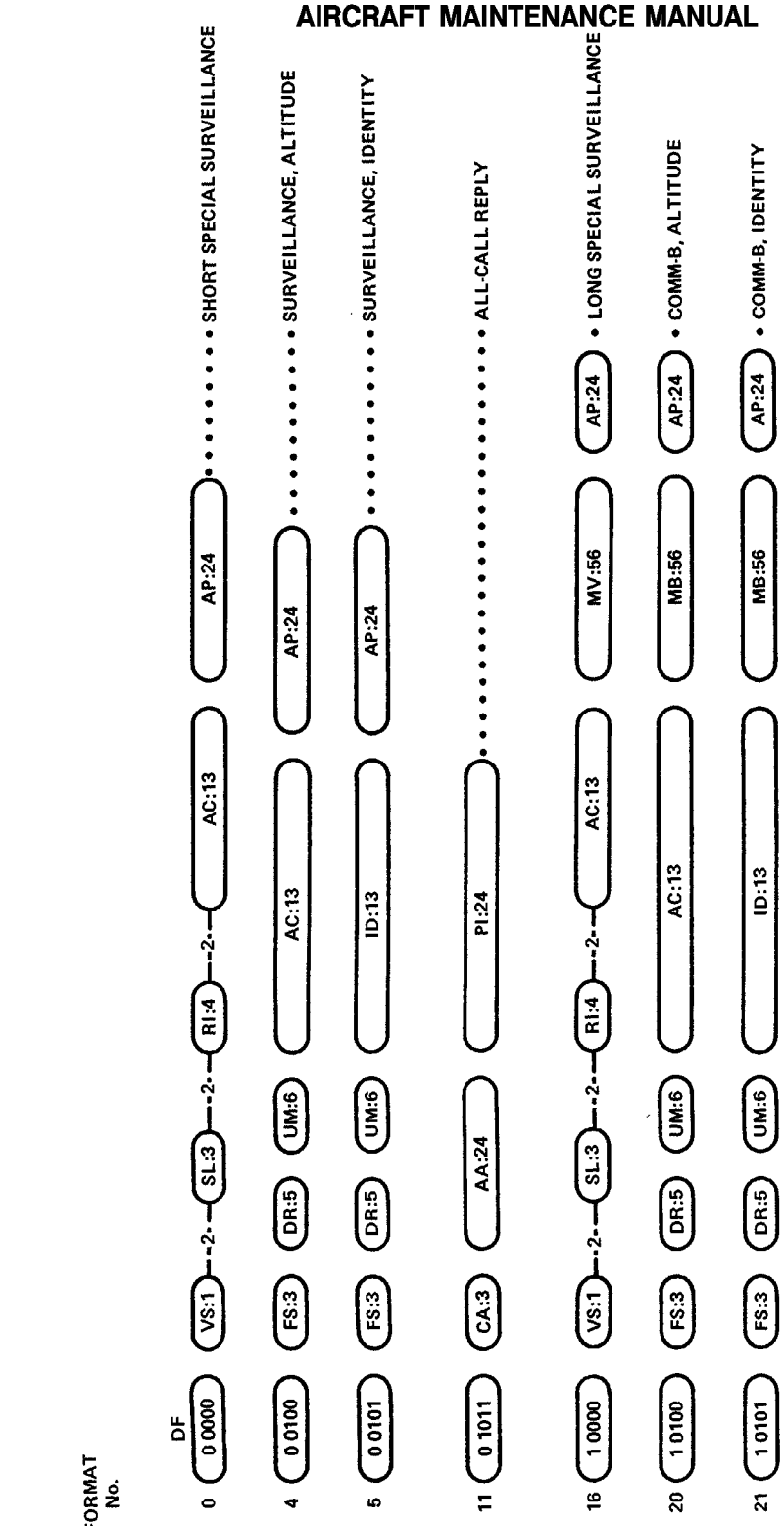


BM5 34 44 00 0 AKM0 · 00

TCAS - Mode S Interrogation and Reply
Figure 021


BM5 34 44 00 0 BFM0 - 00
FORMAT No.
UF
0 0 0000 3 RL:1 CL:1 3 AQ:1 18 AP:24 SHORT SPECIAL SURVEILLANCE
4 0 0100 PC:3 RR:5 DI:3 SD:16 AP:24 SURVEILLANCE, ALTITUDE REQUEST
5 0 0101 PC:3 RR:5 DI:3 SD:16 AP:24 SURVEILLANCE, IDENTITY REQUEST
16 1 0000 3 RL:1 CL:1 3 AQ:1 18 MU:56 AP:24 LONG SPECIAL SURVEILLANCE
20 1 0100 PC:3 RR:5 DI:3 SD:16 MA:56 AP:24 COMM-A, ALTITUDE REQUEST
21 1 0101 PC:3 RR:5 DI:3 SD:16 MA:56 AP:24 COMM-A, IDENTITY REQUEST
NOTE : (1) XX:M DENOTES A FIELD DESIGNATED "XX" WHICH IS ASSIGNED M BITS.
(2) ----N---- DENOTES UNASSIGNED CODING SPACE, N BITS ; MUST BE SET TO ALL ZEROS.
(3) THE FORMAT NUMBER IN THE ABOVE UPLINK FORMATS (UF) CORRESPONDS TO THE BINARY CODE IN THE FIRST 5 BITS OF THE INTERROGATION.
MODE S INTERROGATION OR UPLINK FORMATS USED BY TCAS

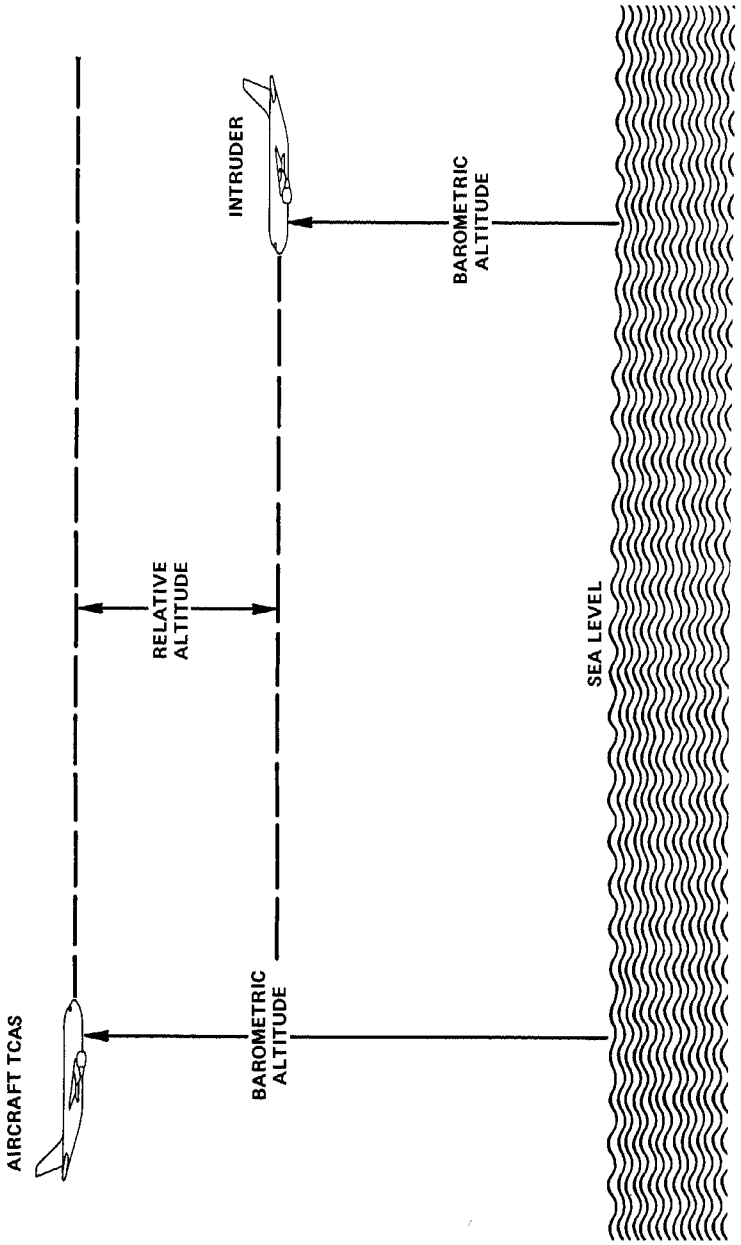
TCAS - Message Uplink Format
Figure 022


FORMAT No.
DF
0 0 0000 VS:1 2 SL:3 2 RI:4 2 AC:13 AP:24 • SHORT SPECIAL SURVEILLANCE
4 0 0100 FS:3 DR:5 UM:6 AC:13 AP:24 • SURVEILLANCE, ALTITUDE
5 0 0101 FS:3 DR:5 UM:6 ID:13 AP:24 • SURVEILLANCE, IDENTITY
11 0 1011 CA:3 AA:24 PI:24 • ALL-CALL REPLY
16 1 0000 VS:1 2 SL:3 2 RI:4 2 AC:13 MV:56 AP:24 • LONG SPECIAL SURVEILLANCE
20 1 0100 FS:3 DR:5 UM:6 AC:13 MB:56 AP:24 • COMM-B, ALTITUDE
21 1 0101 FS:3 DR:5 UM:6 ID:13 MB:56 AP:24 • COMM-B, IDENTITY
NOTE : (1) XX:M DENOTES A FIELD DESIGNATED "XX" WHICH IS ASSIGNED M BITS.
(2) —N— DENOTES UNASSIGNED CODING SPACE, N BITS ; MUST BE SET TO ALL ZEROS.
(3) THE FORMAT NUMBER IN THE ABOVE DOWNLINK FORMATS (DF) CORRESPONDS TO THE BINARY CODE IN THE FIRST 5 BITS OF THE REPLY.
MODE S REPLY OR DOWNLINK FORMATS USED BY TCAS

BM5 34 44 00 0 BGM0 - 00

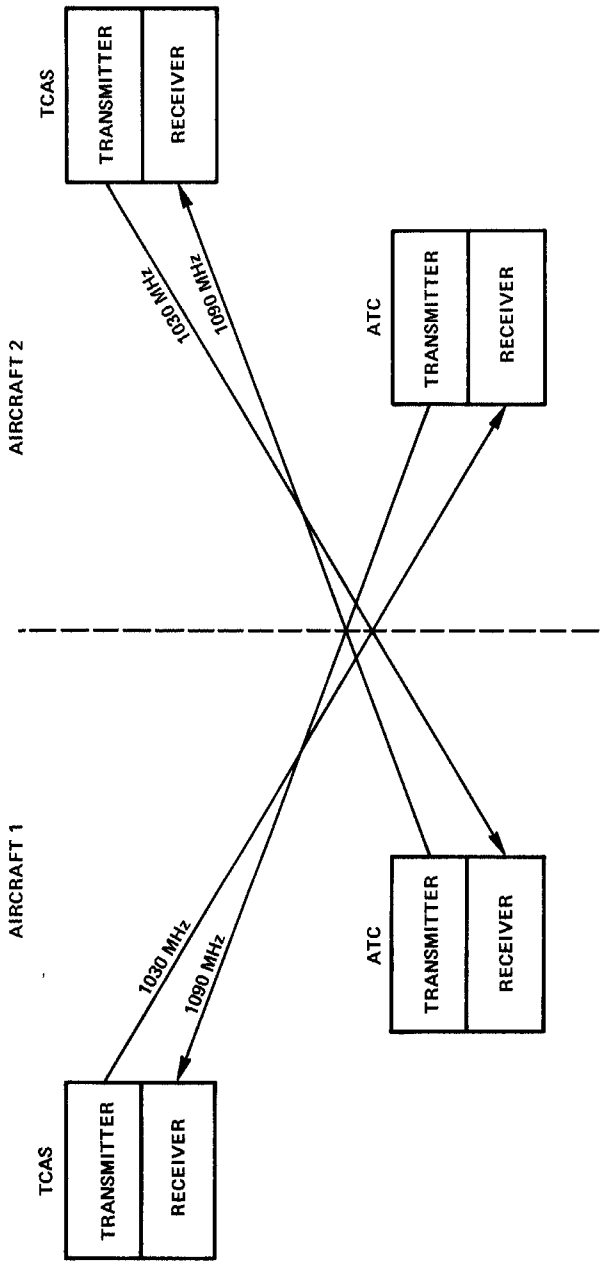
TCAS - Message Downlink Format
Figure 023

B. Intruder Parameters
(Ref. Fig. 024)
(1)Principle
(a)Determination of relative altitude
Upon confirmed transponder reception, the TCAS starts to interrogate the intruder. Its altitude is transmitted directly in the reply (standard barometric altitude) and this information is used to determine the relative altitude of the two aircraft, by calculating the barometric altitude difference.
This computation is, however, only possible with respect to Mode C or Mode S transponder equipped aircraft.
(b)Range measurement
The range is calculated by measuring the elapsed time between transmission of the interrogation signal and return of the reply transmitted by the intruder. Aircraft are detected from a minimum range of 14 NM.
(c)Determination of Azimuth
There are several methods for calculating the angle of reception of a radio-electric signal with respect to a reference direction such as the aircraft centerline.
(d)Tracking
Once identified, the intruders are tracked by a series of interrogation-replies in Mode C only all-call for Mode C transponder-equipped aircraft, and in Mode S for Mode S transponder-equipped aircraft.
These exchanges permit the TCAS to periodically update the altitude, range and bearing data for each intruder and to compute the range rate and altitude rate variations. These data are then used to determine the time separating the two aircraft from their closest point of approach.
(e)Broadcast messages
Every ten seconds, the TCAS transmits a broadcast message intended to inform nearby aircraft, themselves equipped with a TCAS, of the presence of a TCAS-equipped aircraft in their traffic area.
These messages, received by the Mode S transponders, are communicated to the TCAS computer to enable it to know the number of TCAS-equipped aircraft in its detection envelope. This information is then used in the interference limitation formulas whose results modulate the Mode S interrogation output power level in inverse proportion to the number of aircraft. This reduces the number of non-elicited replies received by ground ATC stations.
(f)Communications frequencies
Communications between two aircraft are always crossed between transponder and TCAS. The TCAS transmits at a frequency of 1030 MHz to the transponder of the other aircraft, whose reply signals are at a frequency of 1090 MHz to the TCAS receiver. This choice allows system compatibility with ground station-transponder links as the ground stations use the same frequencies as the TCAS.
(Ref. Fig. 025)



BM5 34 44 00 0 ALM0 · 00

TCAS - Relative Altitude Calculation Principle
Figure 024



BM5 34 44 00 0 AMM0 - 00

TCAS - Communication Principle
Figure 025

C. Coordination

Two TCAS-equipped aircraft must coordinate their maneuvers to avoid the flight path corrections ordered by each TCAS resulting in a hazardous situation.

(1)Coordination principle

In most cases of encounters between two TCAS-equipped aircraft, mutual identification is almost but not quite simultaneous, with sufficient time lag to establish the priority necessary for the coordination process. The first aircraft to detect a potentially dangerous configuration computes a deviation maneuver sense and communicates it to the other aircraft. This aircraft takes the information into account and in turn computes a correction.

If two aircraft detect each other at exactly the same time and simultaneously transmit coordination messages containing incompatible deviation senses it is, by convention, the aircraft that has the highest Mode S address that cancels its trajectory correction. A time delay in the display of orders on the indicators avoids opposing orders.

(2)Communications protocol

Communications between two aircraft comprises three phases :

(a)Detection phase

The TCAS receives squitter messages transmitted by the transponder of the intruder aircraft. These are DF11-type messages transmitted periodically at one second intervals and intended to enable its detection and identification.

This message essentially uses two fields :

- an AA (Address Announced) field containing the Mode S address which must be acknowledged
- A PI (parity interrogator Identity) field which is the result of a parity encoding.

(b)Surveillance phase

After detection, a surveillance phase starts. This phase is composed of an acquisition part and a tracking part.

1 Acquisition interrogation

When the TCAS receives a squitter and acquires the Mode S address of the intruder it enters into contact by transmitting a UFO-type message (Short special surveillance interrogation) with the following specific fields :

- bit 9, RL = 0 : reply message length requested short (56 bits)
- bit 14, AQ = 1 : acquisition-type message indication.

2 Acquisition reply

The intruder's transponder replies to this request by a DFO message containing the following information :

- bit 6, VS : Vertical Status, = 1 if the aircraft is on the ground, = 0 if the aircraft is airborne
- bits 9 to 11, SL : Sensitivity level indicates in which sensitivity level its TCAS is operating
- bits 14 to 17, RI : combinations of bits, from values 8 to 15, specify the maximum speed the aircraft can reach. The other combinations are not used
- bits 20 to 32, AC : aircraft altitude code indicating the barometric altitude.

3 Tracking interrogation
After its acquisition, the intruder is tracked by UFO-type interrogations with the following field values :
- RL = 0 : reply message length requested short
- AQ = 0 : not an acquisition message.

4 Tracking reply
The intruder's transponder replies with a DFO message indicating altitude and TCAS sensitivity level by a combination of fields SL and RI :
- SL : bits 9 to 11
- RI : bits 14 to 17, combination values 0 to 7. Values 8 to 15 are not used
- AC : bits 20 to 32, aircraft altitude code.

(c)Coordination phase

If the intruder becomes a threat, the TCAS programs a deviation maneuver to avoid a risk of collision. A coordination procedure is initiated between the two aircraft with an exchange of the following messages :

1 Coordination interrogation

The TCAS transmits a UF16 Long Special Surveillance message whose fields contain the following indications :

BITS	FIELD	INDICATION
9	RL	= 1 : reply message length requested long
14	AQ	= 0 : non-acquisition type interrogation
33-40	UDS	U Definition Subfield - defines the other data in the MU field (Comm-U), composed of bits 42 to 88
42	MTB	Indicates multiple threat processing
43-44	CVC	Cancel Vertical resolution advisory Complement - used to cancel an RA complement sent earlier to an intruder
45-46	VRC	Vertical Resolution advisory Complement - used to transmit an RA vertical complement to the intruder requesting it not to modify its trajectory (don't climb, don't descend)
47-49	CHC	Cancel Horizontal resolution advisory Complement-not used in TCAS II
50-52	HRC	Horizontal Resolution advisory Complement - not used in TCAS II
53-55		not used
56-60	HSB	Encoded Sense bits for Horizontal resolution advisory complement - not used in TCAS II
61-64	VSB	Encoded Sense Bits for Vertical resolution advisory complement - parity code to protect the 4 vertical command bits (43-46)
65-88	MID	Interrogator TCAS-equipped aircraft Mode S address.

2 Coordination reply

After acquisition of this message, the intruder's transponder replies with a Long Special Surveillance FD 16 type message, containing the information previously transmitted to it by its own TCAS :

BITS	FIELD	INDICATION
6	VS	Vertical Status - indicates whether aircraft is on ground or airborne
9-11	SL	With RI, SL indicates the sensitivity level at which the interrogated aircraft's TCAS is operating
14-17	RI	Reply Information
20-32	AC	Altitude Code - contains aircraft altitude encoded in 100 ft increments if bit 28 equals 0,

BITS	FIELD	INDICATION
		and in 25 ft increments if bit 28 equals 1
33-40	VDS	V Definition Subfield defines the contents of the data and coding in the field MV (Comm V) composed of bits 41 to 88
41-54	ARA	Active Resolution Advisory - indicates the RA type currently generated by the TCAS
55-58	RAC	Resolution Advisory Complement - Indicates the RA complement type currently received from other TCAS-equipped aircraft
59-88		Not used

(d)Correspondence of radio messages with Arinc 429 words

The coordination information exchanged between two aircraft transits via ARINC 429 buses linking the ATC transponder to the TCAS computer. The following table gives the correspondence between the two types of link :

1 - TRANSPONDER TO TCAS

	RADIO MESSAGE		ARINC MESSAGE	
FIELD	MESSAGE	BITS	LABEL	BITS
MTB	UF16	42	271	09
CVC		43-44		10-11
VRC		45-46		12-13
CHC		47-49		14-16
HRC		50-52		17-19
HSB		56-60		20-24
VSB		61-64		25-28

2 - TCAS TO TRANSPONDER

	RADIO MESSAGE		ARINC MESSAGE	
FIELD	MESSAGE	BITS	LABEL	BITS
SL	DF16	09-11	274	23-25
RI		14-17		26-29
ARA		41-54	273	12-25
RAC		55-58		26-29

D. Principles of Computation

In the TCAS, target aircraft are categorized depending on specific criteria varying in function of altitude.

The TCAS essentially uses two types of information to perform this classification :

- the relative altitude between two aircraft, known by the difference of their barometric altitudes with respect to sea level
- the distance or range separating them.

Acquisition of these two parameters at regular intervals (tracking) enables their variations to be calculated :

- altitude rate
- range rate.

Assessement of the potential threat represented by an intruder depends on two criteria determined with respect to a point in the traffic area called Closest Point of Approach (CPA).

This is the point of minimum distance between the two aircraft, assuming that their trajectories do not deviate.

The two criteria are :

- vertical separation at CPA
- time left before reaching CPA.

(Ref. Fig. 026)

(1)Projected vertical separation

The threat is evaluated by calculating the vertical separation between the two aircraft at the closest point of approach.

The TCAS computer processes the current altitude and altitude rate of the intruder to predict whether it will be within limits considered dangerous at the closest point of approach.

Intruder 1 penetrates the altitude zone delimited by the upper and lower thresholds but when it reaches CPA, it will be outside this zone.

Therefore no advisory will be issued.

However, when intruder 2 reaches CPA it is still inside this zone and therefore an advisory will be issued.

(Ref. Fig. 027)

(2)Time to intercept (TAU)

The TCAS does not need to locate the CPA in space, but rather it needs to know the time to intercept for two aircraft. For example, if two aircraft are approaching on the same axis on a collision course, this time is the ratio of distance between them to the sum of their speeds.

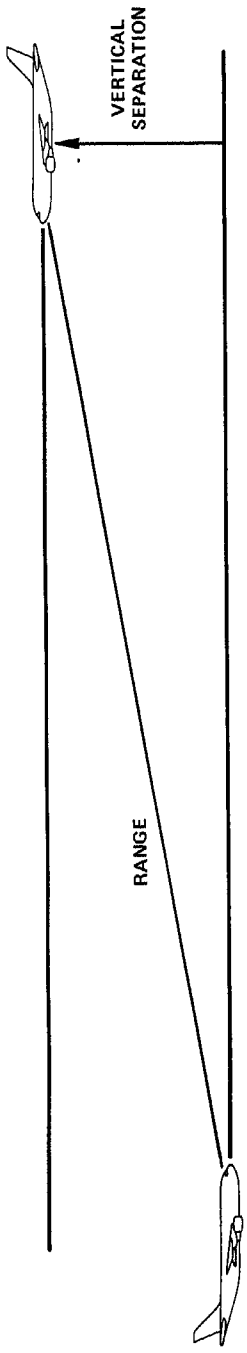
$$T = \frac{D}{V1 + V2}$$

More generally, the TCAS uses range and range rate measurement to compute this time :

$$TAU = \frac{RANGE}{RANGE\ RATE}$$

With the risk of collision being in inverse proportion to this time, trajectory correction orders are initiated by crossing predetermined time thresholds whose values depend on the altitude layer in which the aircraft is located.

This method of calculation avoids the initiation of corrections if, from



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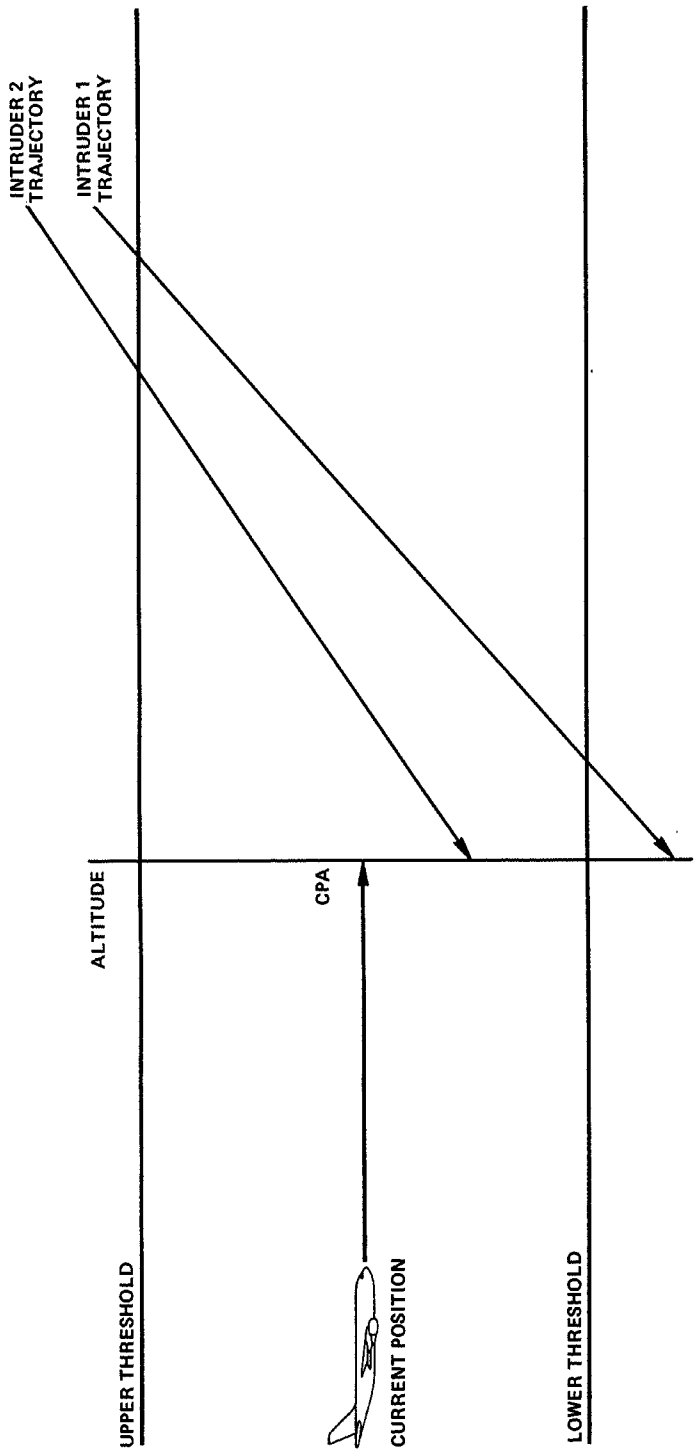
TCAS - Definition of Main Parameters
Figure 026



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TCAS - Threat Evaluation
Figure 027

a certain distance, the TAU trend is inverted even through the distance separating the two aircraft decreases.
This time decreases as the range decreases, reaches a minimum when the intruder's relative bearing is 45° and then increases rapidly. If the time corresponding to a predetermined threshold has not been reached before the minimum TAU value, a trajectory correction will not be initiated.

E. Definition of Target Aircraft

Target aircraft are divided into four categories :

(1)Proximate aircraft

Targets are defined as proximate traffic if the difference between their altitude and that of the TCAS aircraft is less than 1200 ft and if their range is within 6 NM.

Depending on their trajectory, they may :

- conserve this status and move away without an advisory being declared. In this case the pilot is informed of their presence on the VSI/TCAS indicator by a cyan filled diamond symbol and can monitor their progress, or
- have a trajectory liable to lead to a conflict situation and in this case they require a traffic advisory and their symbol changes.

(2)Traffic advisory aircraft

When an intruder is relatively near but does not represent an immediate threat the TCAS issues a traffic advisory. Its presence is displayed on the VSI/TCAS indicator by an amber/yellow filled circle. Its display is accompanied by an aural alert :

"Traffic Traffic".

The pilot is therefore aware of its presence and knows its range and relative bearing. Its display is linked to vertical separation and time TAU before CPA values.

Depending on its trajectory, an intruder may conserve this status and move away, or it may become a collision threat. In this case avoidance maneuvers are suggested to the pilot via a resolution advisory.

(3)Resolution advisory aircraft

In resolution displays, the intruder is represented on the VSI/TCAS indicator by a red filled square and corrective orders are issued on the vertical speed scale. Crossing into resolution advisory occures for a TAU time threshold 10 to 15 seconds lower than a traffic advisory threshold. Vertical separation between the two aircraft is also taken into account for this category. There are two types of resolution advisory, in function of the vertical separation value :

- Preventive Advisories
- Corrective Advisories.

(a)Preventive Advisory

In this case the vertical separation is less than a threshold S1 and greater than a threshold S2. The advisory instructs the pilot to avoid certain deviations from current vertical rate, this measure being sufficient to avoid a risk of collision. On the VSI/TCAS indicator speed scale, the forbidden values are indicated by red arcs.

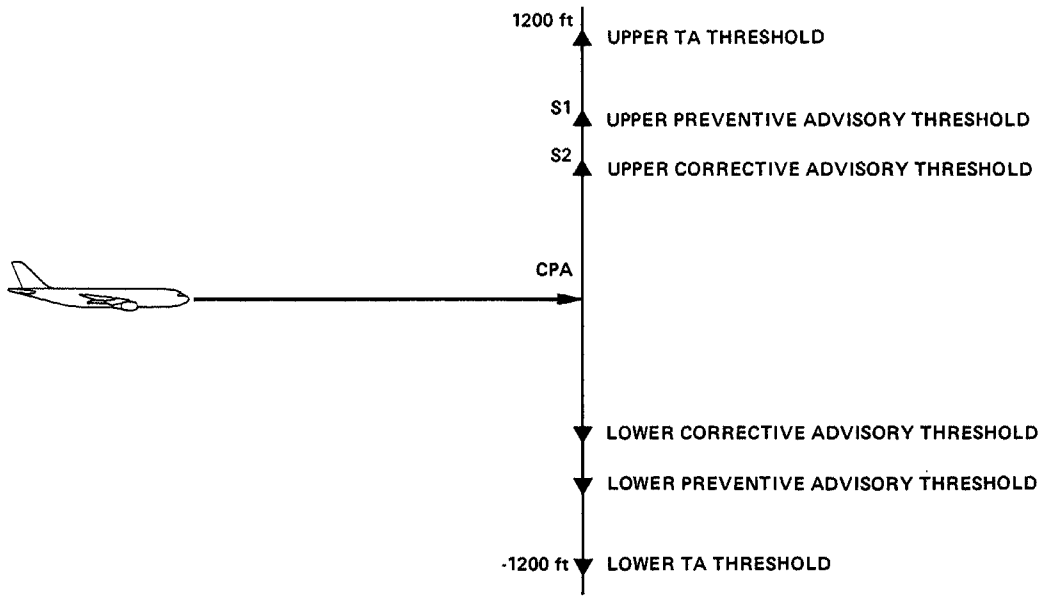
(b)Corrective advisory

In this case, the vertical separation is lower than the threshold S2. On the VSI/TCAS indicator vertical speed scale, colored arcs depict avoidance maneuvers to be performed :

- red arc = forbidden vertical speeds
- green "fly to" arc = a vertical speed range to be respected.

(Ref. Fig. 028)

**ON A/C 005-100,



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TCAS - Threat Threshold Scale
Figure 028

(c)Aural alerts
Trajectory correction or holding visual orders are accompanied by synthesized voice announcements generated by the TCAS computer on the aircraft audio system. These messages and their meanings are described below :
- "CLIMB, CLIMB, CLIMB".
Climb at the rate shown by the green arc on the RA indicator (+1500 ft/mn),
- "CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB".
As above except that it further indicates that own flight path will cross through that of the intruder,
- "REDUCE CLIMB, REDUCE CLIMB".
Reduce vertical speed to that shown by the green arc on the RA indicator,
- "INCREASE CLIMB, INCREASE CLIMB" (+1500 ft/mn)
Follows a "climb" advisory. The vertical speed of the aircraft should be increased to that shown on the RA indicator,
- "CLIMB, CLIMB NOW, CLIMB, CLIMB NOW".
Follows a "descend" advisory when a reversal in sense is required to achieve safe vertical separation from a maneuvering intruder,
- "DESCEND, DESCEND, DESCEND" (-1500 ft/mn)
Descend at the rate indicated by the green arc on the RA indicator,
- "DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND"
As above except that it further indicates that own flight path will cross through that of the intruder,
- "REDUCE DESCENT, REDUCE DESCENT"
Reduce vertical speed to that shown by the green arc on the RA indicator,
- "INCREASE DESCENT, INCREASE DESCENT" (-2500 ft/mn)
Follows a "descend" advisory. The vertical speed of the descent should be increased to that shown on the RA indicator,
- "DESCEND NOW, DESCEND NOW"
Follows a "climb" advisory when a reversal in sense is required to achieve safe vertical separation from a maneuvering intruder.
Two other aural advisories are also generated :
- "MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED"
Indicates that a forbidden vertical speed range exists (red arc) and that pilot must monitor vertical speed so as not to enter this range (Preventive Advisory).
This message is spoken only once if softening from a previous corrective advisory,
- "CLEAR OF CONFLICT"
Indicates that separation has been achieved and range has started to increase.

**ON A/C 101-200,

(c)Aural alerts
Trajectory correction or holding visual orders are accompanied by synthesized voice announcements whose level cannot be adjusted by the pilot. These announcements are generated by the TCAS computer

and broadcast via the flight compartment loudspeakers.
These messages and their meanings are described below :
- "CLIMB, CLIMB".
Climb at the rate shown by the green arc on the RA indicator (+1500 ft/mn),
- "CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB".
As above except that it further indicates that own flight path will cross through that of the intruder,
- "INCREASE CLIMB, INCREASE CLIMB" (+2500 ft/mn)
Follows a "climb" advisory. The vertical speed of the aircraft should be increased to that shown on the RA indicator,
- "CLIMB, CLIMB NOW, CLIMB, CLIMB NOW".
Follows a "descend" advisory when a reversal in sense is required to achieve safe vertical separation from a maneuvering intruder,
- "DESCEND, DESCEND" (-1500 ft/mn)
Descend at the rate indicated by the green arc on the RA indicator,
- "DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND"
As above except that it further indicates that own flight path will cross through that of the intruder,
- "INCREASE DESCENT, INCREASE DESCENT" (-2500 ft/mn)
Follows a "descend" advisory. The vertical speed of the descent should be increased to that shown on the RA indicator,
- "DESCEND, DESCEND NOW, DESCEND, DESCEND NOW"
Follows a "climb" advisory when a reversal in sense is required to achieve safe vertical separation from a maneuvering intruder.
- "ADJUST VERTICAL SPEED, ADJUST" :
Reduce vertical speed to that shown by the green arc on the RA indicator.
It can correspond to a corrective reduce climb or reduce descent.
It can also represent a weakening of corrective RA.
Four other aural advisories are also generated :
- "MONITOR VERTICAL SPEED"
Indicates that a forbidden vertical speed range exists (red arc) and that pilot must monitor vertical speed so as not to enter this range (Preventive Advisory).
- "MAINTAIN VERTICAL SPEED, MAINTAIN" :
Indicates a non-crossing advisory type, maintains rate RA's (corrective).
- "MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN" :
Indicates an altitude crossing advisory type, maintains rate RA's (corrective).
- "CLEAR OF CONFLICT"
Indicates that separation has been achieved and range has started to increase.

**ON A/C 005-200,

(4)Other traffic
Aircraft detected by the TCAS are defined as "other traffic" and displayed on the VSI/TCAS indicator if :
- they are within ± 2700 ft vertically and within 6 NM of own aircraft

- and if they do not enter in the "proximate", "TA", or RA categories. These targets are represented by a cyan diamond, outline only, on the VSI/TCAS indicator.

**ON A/C 005-100,

NOTE : For TCAS system equipped with the ABOVE/BELOW function, the Vertical Speed Indicators display the "other traffic" inside an envelope which can reach ± 9900 ft in altitude (according to the TCAS computer and ATC/TCAS control unit installed) and 14 NM in range.

**ON A/C 101-200,

(5)Advisory inhibit conditions
In certain particular conditions, certain advisories are not generated as they could lead to the pilot adopting flight conditions that are hazardous or outside the aircraft's performance capability.
(a)Low altitude inhibitions
Ground proximity leads to the inhibition of those advisories liable to cause a hazardous situation at this level. In decreasing altitude, these are :
- below 1450 ft Above Ground Level (AGL) inhibition of "Increase Descend" Resolution Advisories (RA)
- below 1200 ft AGL at take-off and 1000 ft AGL in approach, inhibition of "Descend" Resolution Advisories (RA)
- below 500 ft AGL, inhibition of all Resolution Advisories (RA)
- below 400 ft AGL, inhibition of aural Traffic Advisories (TA).

(b)High altitude inhibition
Above 38,000 ft, further climb orders are inapplicable as the aircraft performance capability does not permit them to be taken into account. "Climb" advisories are therefore inhibited above this altitude.
(c)Rejection of signals from aircraft on ground

**ON A/C 005-100,

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- below 500 ft AGL, inhibition of all Resolution Advisories (RA)
- below 400 ft AGL, inhibition of aural Traffic Advisories (TA).

(b)High altitude inhibition

Above 48,000 ft, further climb orders are inapplicable as the aircraft performance capability does not permit them to be taken into account. "Climb" advisories are therefore inhibited above this altitude.

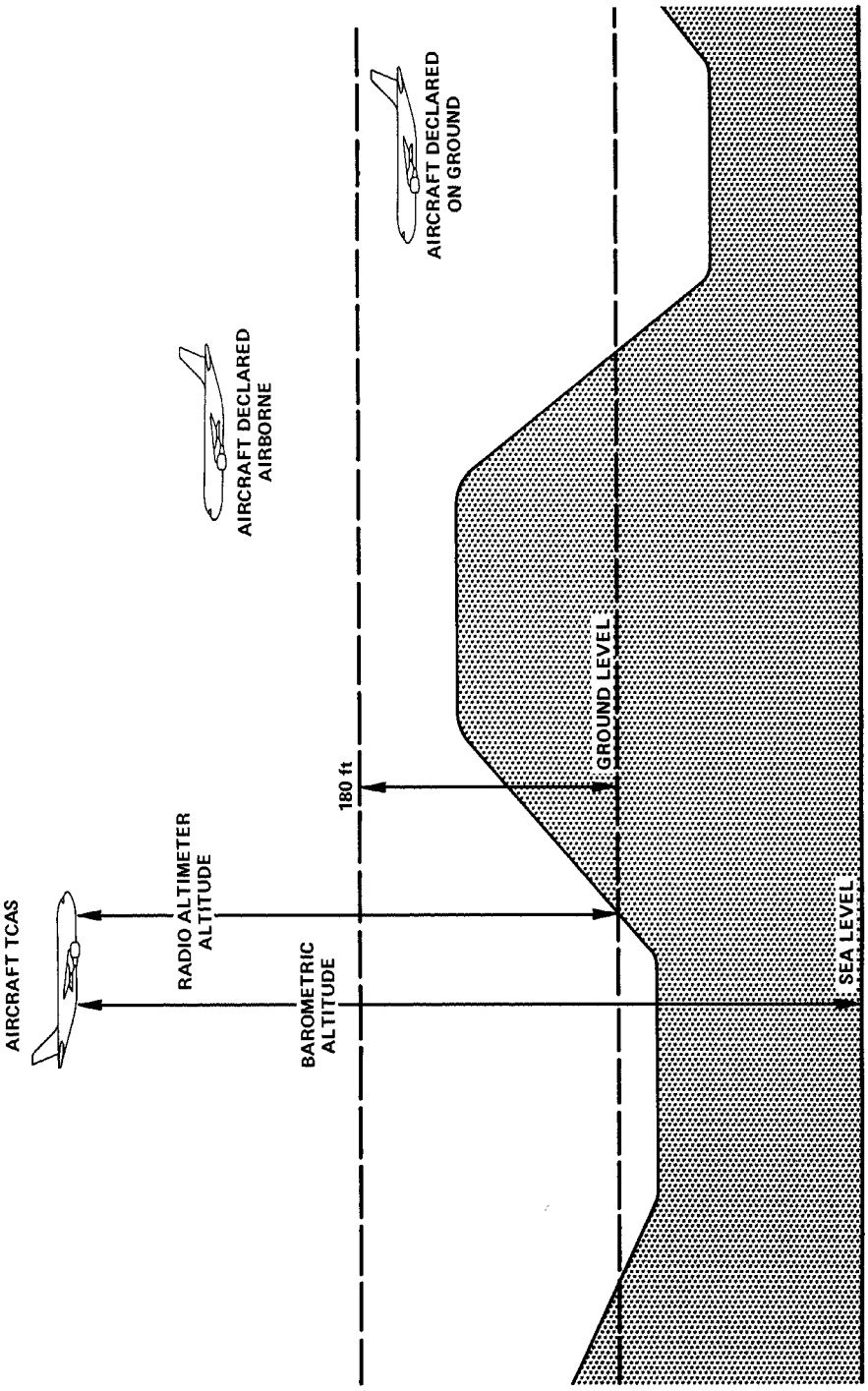
(c)Rejection of signals from aircraft on ground
(Ref. Fig. 029)

**ON A/C 101-200,

(Ref. Fig. 030)

**ON A/C 005-100,

Aircraft on the ground may reply to TCAS interrogations, producing an unnecessary overload in the processing and display of information. For this reason, the TCAS systematically eliminates responses from aircraft at an altitude below 180 ft when its own altitude is itself below 1700 ft AGL.
But, as the altitude transmitted by the intruder is a barometric altitude with respect to sea level, the TCAS shall process this value to convert it into height above ground level in order to compare it with the 180 ft threshold.
The intruder's height above ground level can be deduced :
Z i/s = Z t/s -(Z t/m - Z i/m)
where : Z i/s = height of intruder above ground level
Z i/m = altitude of intruder above sea level
Z t/s = height of TCAS above ground level measured by radio altimeter
Z t/m = altitude of TCAS above sea level measured by ADC.



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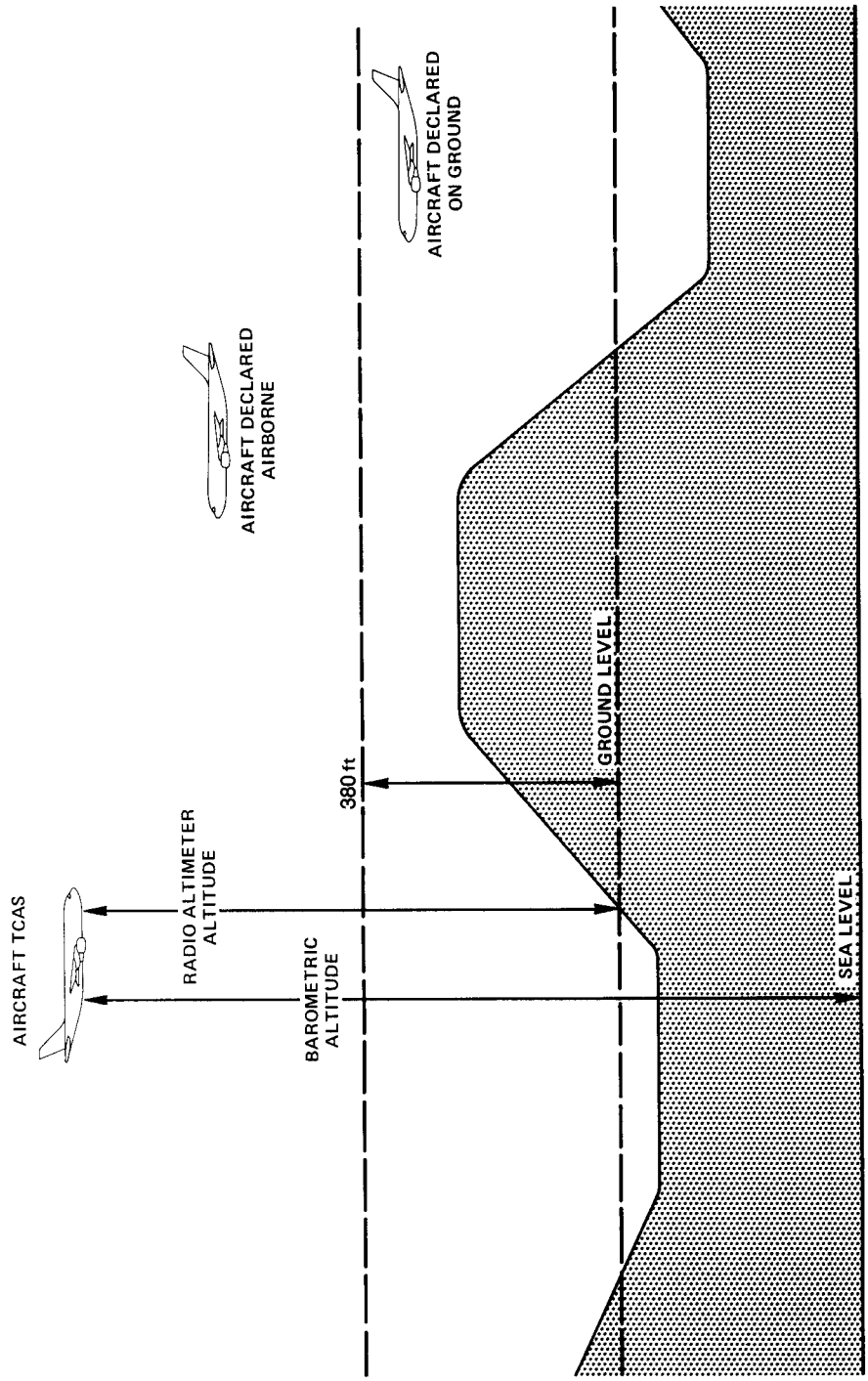
TCAS - Inhibition Condition
Figure 029



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TCAS - Inhibition Condition
Figure 030

F. Sensitivity Level

The notion of sensitivity level is very important in the TCAS as many of the operating modes depend on it.

The TCAS separates the surrounding airspace into altitude layers. A different Sensitivity Level (SL) threshold for issuing advisories is applied to each altitude layer.

The sensitivity level is decreased at low altitude to prevent unecessary advisories in higher traffic densities such as terminal areas.

Generally, the level is determined automatically by the TCAS in function of :

- altitude values from the radio altimeter up to 2500 ft AGL
- barometric altitude values in the 2500 ft to 48,000 ft range. TAU values corresponding to each sensitivity level indicate the TA and RA thresholds. The vertical separation thresholds at CPA also vary in function of the sensitivity level for the different types of advisory.

Table of Sensitivity Level

Source Altitude	Altitude	TAU thresholds SL	TA (sec)	RA (sec)	Vertical separation thresholds SO TA (ft)	S1 RA prev (ft)	S2 RA cor (ft)
Radio Alt	<500	2	20		1200	750	400
Radio Alt	500-2500	4	35	20	1200	750	400
Baro	2500-10000	5	40	25	1200	750	400
Baro	10000-20000	6	45	30	1200	750	500
Baro	20000-30000	7	45	35	1200	850	640
Baro	> 30000	7	48	35	1200	950	750

**ON A/C 101-200,

Aircraft on the ground may reply to TCAS interrogations, producing an unnecessary overload in the processing and display of information. For this reason, the TCAS systematically eliminates responses from aircraft at an altitude below 180 ft when its own altitude is itself below 1700 ft AGL.

But, as the altitude transmitted by the intruder is a barometric altitude with respect to sea level, the TCAS shall process this value to convert it into height above ground level in order to compare it with the 180 ft threshold.

The intruder's height above ground level can be deduced :

$Z\ i/s = Z\ t/s - (Z\ t/m - Z\ i/m)$

where : Z i/s = height of intruder above ground level
Z i/m = altitude of intruder above sea level
Z t/s = height of TCAS above ground level measured by radio

altimeter
Z t/m = altitude of TCAS above sea level measured by ADC.

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Table of Sensitivity Level

		TAU thresholds			Vertical separation thresholds		
Source Altitude	Altitude	SL	TA (sec)	RA (sec)	SO TA (ft)	S1 RA prev (ft)	S2 RA cor (ft)
Radio Alt	<1000	2	20		850		
Radio Alt	1000-2350	3	25	15	850	600	300
Baro	2350-5000	4	30	20	850	600	300
Baro	5000-10000	5	40	25	850	600	350
Baro	10000-20000	6	45	30	850	600	400
Baro	20000-42000	7	48	35	850	700	600
Baro	> 42000	7	48	35	1200	800	700

NOTE : Level 1 corresponds to Standby Mode in which no advisory is generated.
NOTE : This table indicates the threshold based on own aircraft altitude. Each aircraft altitude depends on hysteresis :
1000 ± 100 ft ; 2350 ± 200 ft ; 5000 ± 500 ft;
10000 ± 500 ft ; 20,000 ± 500 ft ; 42,000 ± 500 ft.
For example, to switch from sensitivity level 3 to sensitivity level 2, the altitude must fall below 900 ft. However, to switch from sensitivity level 2 to sensitivity level 3, the altitude value must go above 1100 ft.

**ON A/C 005-100,

(Ref. Fig. 031)

**ON A/C 101-200,

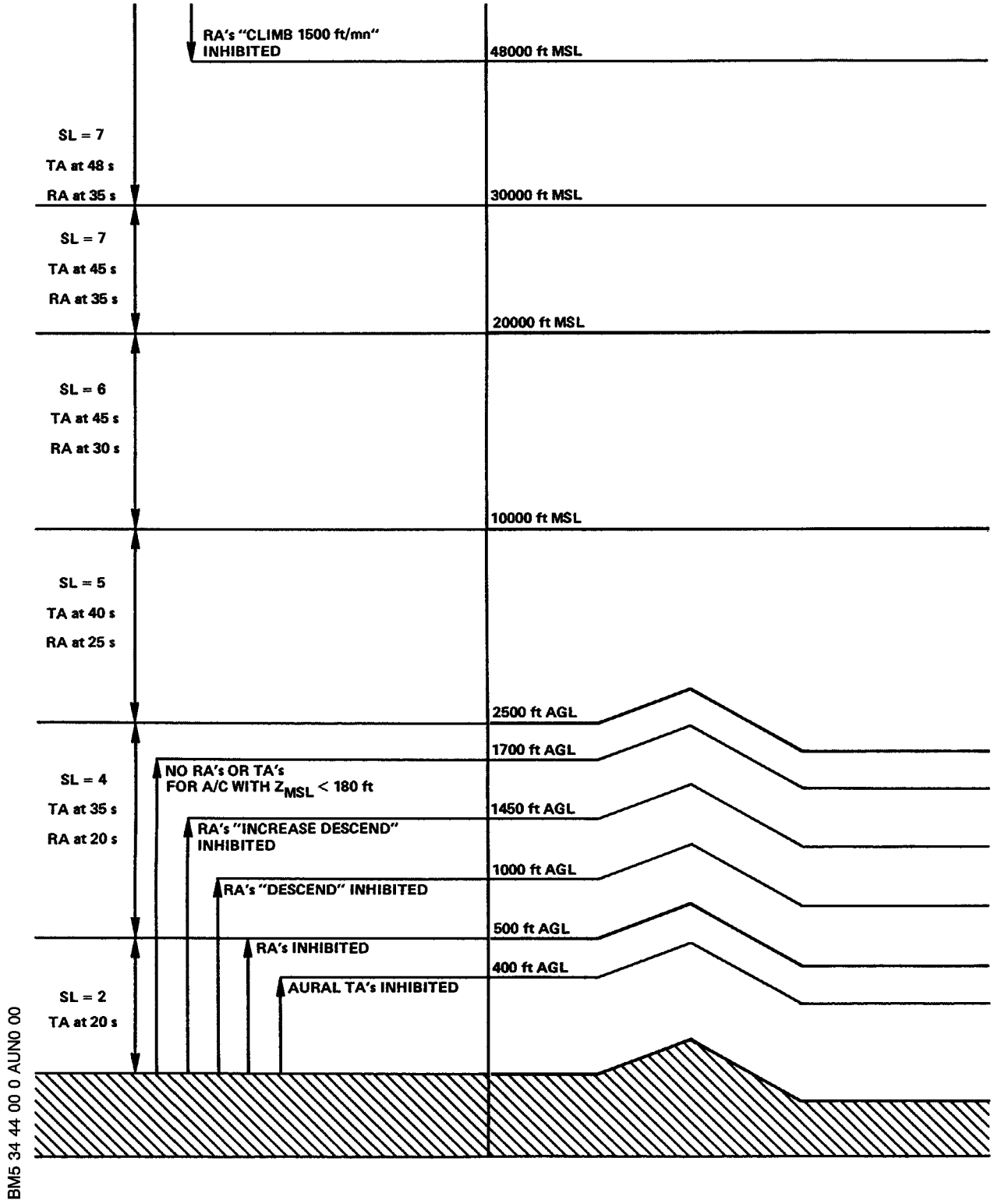
(Ref. Fig. 032)

**ON A/C 005-100,

There are two other means of modifying the sensitivity level :
- selecting TA only mode on the ATC/TCAS control unit forces level 2. In this case, intruders of all types are displayed but will not be transformed into RA symbols and no vertical speed modification indications will be issued. The TA ONLY flag will be displayed on the VSI/TCAS indicator.

If the Standby Mode is selected, no advisories are generated, traffic display and interrogations are inhibited and the TCAS OFF flag is displayed on the indicator.
- the ATC Mode S-equipped ground stations may modify the sensitivity level of the aircraft TCAS via the uplink without, however, having the capability to force the Standby Mode. If several ground stations command sensitivity levels, the TCAS logic selects the lowest level.

Definition of priority logic
1. First a sensitivity level based on altitude is selected.
2. ATC/TCAS control unit input is read by the TCAS computer. If the pilot has selected Automatic Mode (TA/RA), then the altitude-based sensitivity level will be used in comparisons to determine the final level.
3. From all sensitivity level commands, if any, received from ground stations, the lowest is selected.
4. If the TA ONLY mode is selected, either manually via the control unit or by a ground station, the altitude-based sensitivity level is used for TA thresholds and the RAs are inhibited. Otherwise, the lowest of all inputs is chosen.



TCAS - Separation into Altitude Layers
Figure 031

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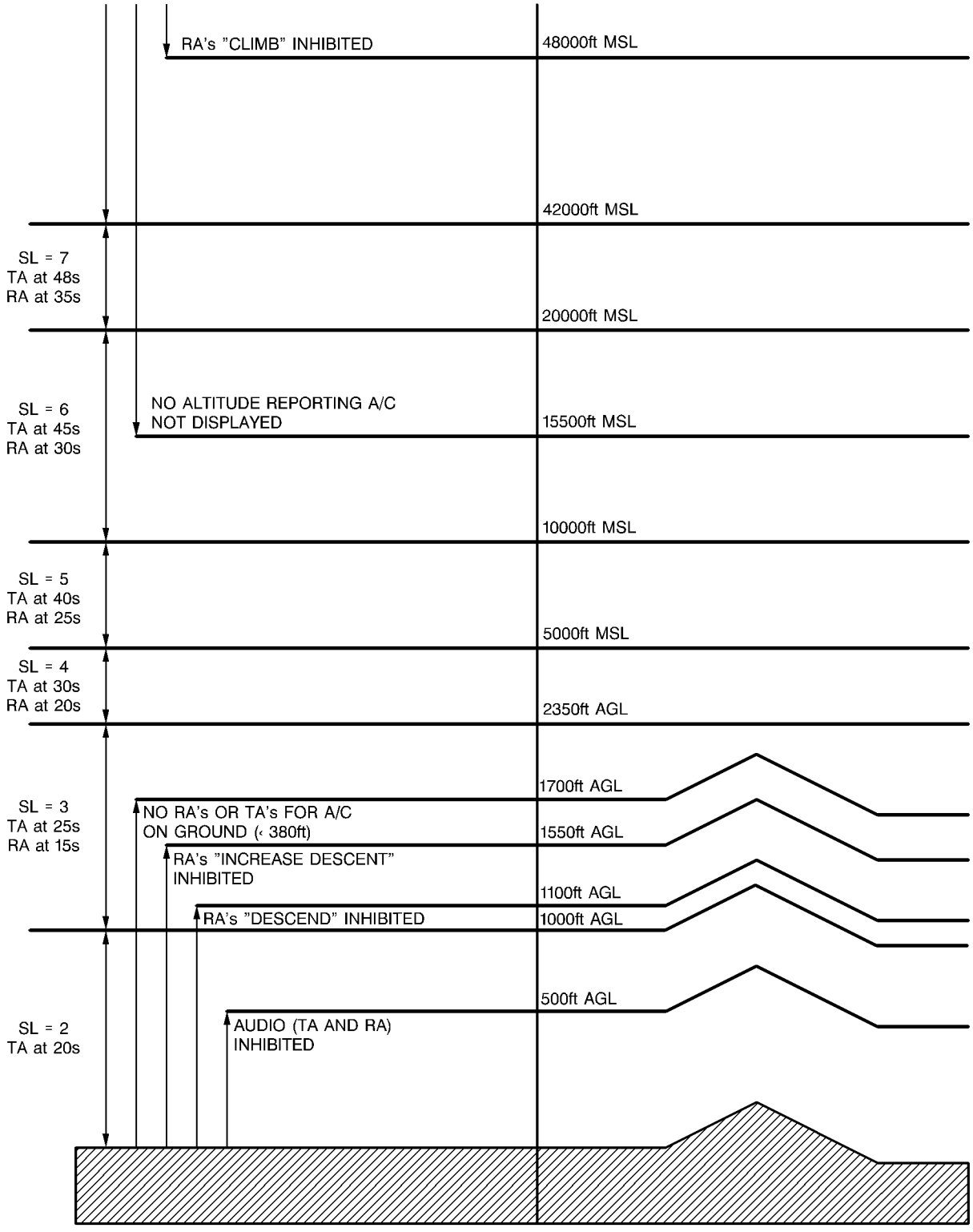

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TCAS - Separation into Altitude Layers
Figure 032

**ON A/C 101-200,

There are two other means of modifying the sensitivity level :
- selecting TA only mode on the ATC/TCAS control unit forces level 2. In this case, intruders of all types are displayed but will not be transformed into RA symbols and no vertical speed modification indications will be issued. The TA ONLY flag will be displayed on the VSI/TCAS indicator.

If the Standby Mode is selected, no advisories are generated, traffic display and interrogations are inhibited and the TCAS OFF flag is displayed on the indicator.
- the ATC Mode S-equipped ground stations may modify the sensitivity level of the aircraft TCAS via the uplink without, however, having the capability to force the Standby Mode. If several ground stations command sensitivity levels, the TCAS logic selects the lowest level.

Definition of priority logic :
1. First a sensitivity level based on altitude is selected. Level 2 is selected if the radio altimeter altitude is less than 1000 ft. Level 2 is also selected if own aircraft is configured such that both CLIMB and DESCEND RAs are inhibited (e.g., below 1000 ft AGL with insufficient climb performance). Level 3 is selected if the aircraft is above 1000 ft and below 2350 ft AGL. If the aircraft is above 2350 ft AGL, barometric altitude is used to select either level 4 (from 2350 to 5000 ft), level 5 (below 10,000 ft), level 6 (from 10,000 to 20,000 ft) or level 7 (above 20,000 ft).
2. ATC/TCAS control unit input is read by the TCAS computer. If the pilot has selected Automatic Mode (TA/RA), then the altitude-based sensitivity level will be used in comparisons to determine the final level.
3. From all sensitivity level commands, if any, received from ground stations, the lowest is selected.
4. If the TA ONLY mode is selected, either manually via the control unit or by a ground station, the altitude-based sensitivity level is used for TA thresholds and the RAs are inhibited. Otherwise, the lowest of all inputs is chosen.

**ON A/C 005-200,

G. Display on VSI/TCAS Indicator
The VSI/TCAS indicator is an instrument with a liquid crystal display that presents two types of information :
- vertical speed indicated by a needle on a circular scale (VSI)
- TCAS traffic and avoidance maneuver indications (TA/RA).

(1)Target altitude indications
Target altitude indications consist of :
- a data tag consisting of digital data and a plus or minus sign indicating the standard barometric altitude difference between the two aircraft in hundreds of feet
- an arrow to the right of the symbol indicating the vertical trend of the target. The data tag and vertical trend arrow are placed above or below the traffic symbol when the target is above or below own aircraft respectively.

Co-altitude situations are depicted as 00 (without the + or - symbol). The 00 symbol is placed above the traffic symbol if the target closed from above, and below if the target closed from below. Vertical trend is indicated by the arrow to the right of the symbol. If no trend information is available the co-altitude 00 symbol is placed below the traffic symbol.

NOTE : An RA cannot be generated for non-altitude reporting aircraft (aircraft equipped with Mode A transponder).

(Ref. Fig. 033)

(2)"No bearing" intruder
When target directional information cannot be derived, its position cannot be indicated on the display. In this case, "Other" and "proximate" traffic are not presented.
Display of traffic generating a TA or RA is replaced by an alphanumeric message in the lower center of the display, colored to conform to the threat level and presented as follows :

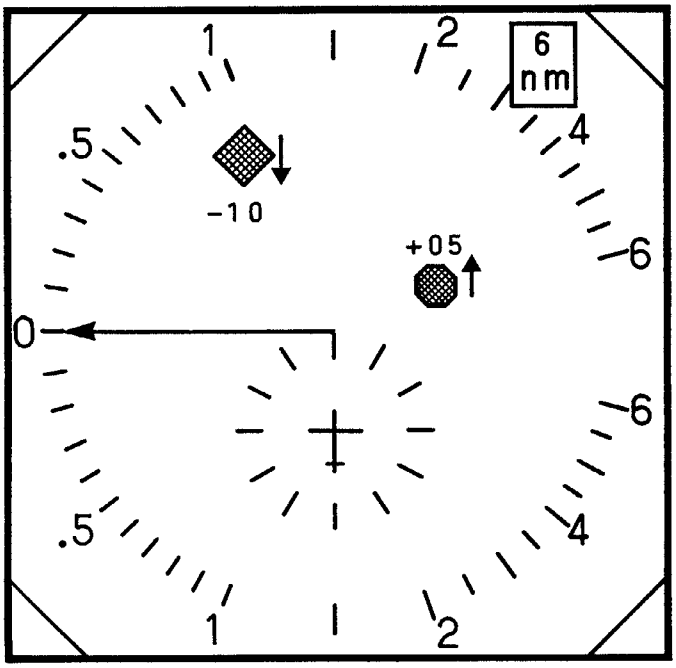
XX YY.Y sWW F

XX : TA or RA appropriate
YY.Y : range in NM and tenths of NM rounded off to the lower nearest tenth
sWW : two digits preceded by a sign (except in a co-altitude situation) indicating the relative altitude if available
F : an arrow pointing upwards if the intruder is ascending and downwards if the intruder is descending.

Two "no bearing" advisories can be displayed simultaneously.

(3)Resolution display (Ref. Fig. 014)
Resolution advisories are represented on the vertical speed scale by indications given in the form of colored arcs :
- a red arc represents the "forbidden" vertical speeds
- a green "Fly-to" arc indicates the vertical speed range the aircraft should fly in to avoid a collision threat represented by one or more intruders.

(a)Corrective advisory display
Corrective resolution advisories are displayed to advise the crew to



BM5 34 44 00 0 AWM0 - 00

TCAS - VSI/TCAS Indicator Display
Figure 033

perform an avoidance maneuver in the vertical sense.
This maneuver may take different forms :
- climb or descent if the aircraft is in level flight
- reducing or increasing rate of climb or reversing to descent if the aircraft is in climb
- reducing or increasing rate of descent or reversing to climb if the aircraft is in descent.

The pilot's task is to maneuver the aircraft promptly to keep the needle out of the red arc and place it in the adjacent green "Fly-to" arc.

(b)Preventive advisory display
Preventive resolution advisories advise the pilot to avoid vertical speeds that could lead to a hazardous situation.
They are represented by one or two red arcs on the vertical speed scale. The pilot must keep the vertical speed of his aircraft outside of these zones.
For example, if own and intruder's flight paths are horizontal and cross through each other, the intruder being at a higher flight level, if the vertical separation is sufficient the pilot is advised to avoid any climb maneuvers by the positive red arc on the vertical speed scale. This display indicates that the aircraft may remain at its present level or may descend but must not climb.
If intruders are detected above and below, red arcs are displayed on both top and bottom of the vertical speed scale, advising the pilot to maintain the aircraft at its current level. In this case a green "Fly-to" arc is displayed in the ± 200 ft zone.

**ON A/C 005-100,

(4)Flags and Messages annunciated on the VSI/TCAS indicator.
As well as intruder information, the indicator also displays indicator status-reporting flags and messages.
When the TCAS is in Standby Mode a white "TCAS OFF" flag is displayed in the center right of the VSI/TCAS indicator.
In TA or TA/RA mode as appropriate, the indicator will display :
- "TA ONLY" in the bottom right corner. The flag is yellow if a TA intruder is detected, otherwise it is white
- "TD FAIL" - yellow - in the center right to indicate a Traffic Display function failure
- "TCAS FAIL" - yellow - in the center right if a TCAS system failure is detected
- "OFF SCALE" - white - in the bottom left corner if a TA or RA type intruder is off the display scale of the indicator. The intruder is represented by one half of the appropriate symbol placed at the edge of the active display area in the direction of the measured bearing of the traffic.

Display priority is, in decreasing order : - "TCAS FAIL, TD FAIL, TCAS OFF, TEST".
The following flags and messages may be displayed in the top left corner :
- "IVS" - yellow - indicating that inertial vertical speed informa-

tion is not available. In this case the indicator uses information input from the selected ADC
- "V/S" - yellow - if ADC information is invalid. The flag is cleared after manual switching to the standby ADC bus and if the information input from this bus is valid.

In the top right corner the following flag may be displayed :
- "RA FAIL" - yellow - if the indicator cannot display resolution advisories or if the information transmitted by the TCAS is invalid (label 270), or if the V/S flag is displayed.

(5)RA DISPLAY STATUS discrete

The TCAS computer is provided with VSI/TCAS indicator status information by an RA DISPLAY STATUS discrete output at ground state.
If an indicator failure prevents it from displaying resolution advisories in TA/RA mode this discrete changes to open state to indicate to the TCAS computer that the display is invalid.
A system failure message is then issued by the TCAS to the indicator and the "TCAS FAIL" flag is displayed.

**ON A/C 101-200,

(4)Flags and Messages annunciated on the VSI/TCAS indicator.

As well as intruder information, the indicator also displays indicator status-reporting flags and messages.
When the TCAS is in Standby Mode a white "TCAS OFF" flag is displayed in the center right of the VSI/TCAS indicator.
In TA or TA/RA mode as appropriate, the indicator will display :
- "TA ONLY" in the bottom right corner. The flag is yellow if a TA intruder is detected, otherwise it is white
- "TD FAIL" - yellow - in the center right to indicate a Traffic Display function failure
- "TCAS FAIL" - yellow - in the center right if a TCAS system failure is detected
- "OFF SCALE" - white - in the bottom left corner if a TA or RA type intruder is off the display scale of the indicator. The intruder is represented by one half of the appropriate symbol placed at the edge of the active display area in the direction of the measured bearing of the traffic.

Display priority is, in decreasing order : - "TCAS FAIL, TD FAIL, TCAS OFF, TEST".
The following flags and messages may be displayed in the top left corner :
- "IVS" - yellow - indicating that inertial vertical speed information is not available. In this case the indicator uses information input from the selected ADC
- "V/S" - red - if ADC information is invalid. The flag is cleared after manual switching to the standby ADC bus and if the information input from this bus is valid.

In the top right corner the following flag may be displayed :
- "RA FAIL" - yellow - if the indicator cannot display resolution advisories or if the information transmitted by the TCAS is invalid (label 270), or if the V/S flag is displayed.

(5)RA DISPLAY STATUS discrete

The TCAS computer is provided with VSI/TCAS indicator status information by an RA DISPLAY STATUS discrete output at ground state.

If an indicator failure prevents it from displaying resolution advisories in TA/RA mode this discrete changes to open state to indicate to the TCAS computer that the display is invalid.

A system failure message is then issued by the TCAS to the indicator and the "TCAS FAIL" flag is displayed.

**ON A/C 005-100,

6. Test

A. Self-Test
A functional test of the TCAS installation can be initiated by means of the selector switch in TEST position on the ATC/TCAS control unit.

**ON A/C 101-200,

6. Test

A. Self-Test
A functional test of the TCAS installation can be initiated by means of the selector switch in TEST position on the ATC/TCAS control unit or AVIONICS SYS TEST/ATC/TCAS pushbutton switch located on panel 47OVU.

**ON A/C 005-200,

This test can also be triggered by the pushbutton switch on the front of the TCAS computer.
The self-test sequence checks the main functions of the computer and transmits to the indicators :
- resolution advisory characteristics (0 ft/mn advisory, up corrective advisory, don't descend, don't climb > 2000 ft/mn) on label 270
- label frames 130, 131, 132 containing four intruder data according to the following table :

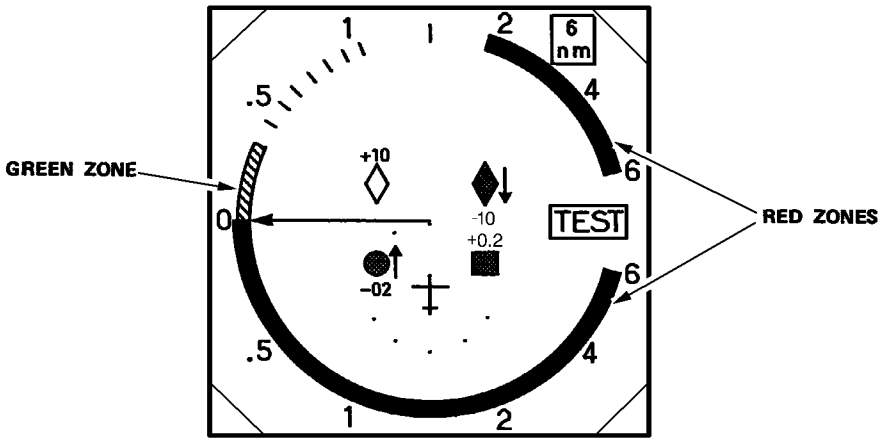
INTRUDER	TYPE	RANGE (NM)	REL ALT (FEET)	BEARING (DEG)	VERTICAL RATE
1	RA	2.00	+200	+90	no vertical rate
2	TA	2.00	-200	-90	climbing
3	PROX	3.625	-1000	+33.75	descending
4	OTHER	3.625	+1000	-33.75	no vertical rate

The shapes and colors of the traffic symbols are :
- cyan diamond, outline only for "Other traffic"
- cyan filled diamond for "Proximate traffic"
- amber/yellow filled circle for TA traffic
- red filled square for RA traffic.

At the same time, red and green arcs are displayed on the vertical speed scale.
The test sequence lasts 12 seconds and ends with a display indicating test validity.

**ON A/C 101-200,

(Ref. Fig. 034)



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TCAS - Self Test Pattern
Figure 034

**ON A/C 005-100,

(Ref. Fig. 035)

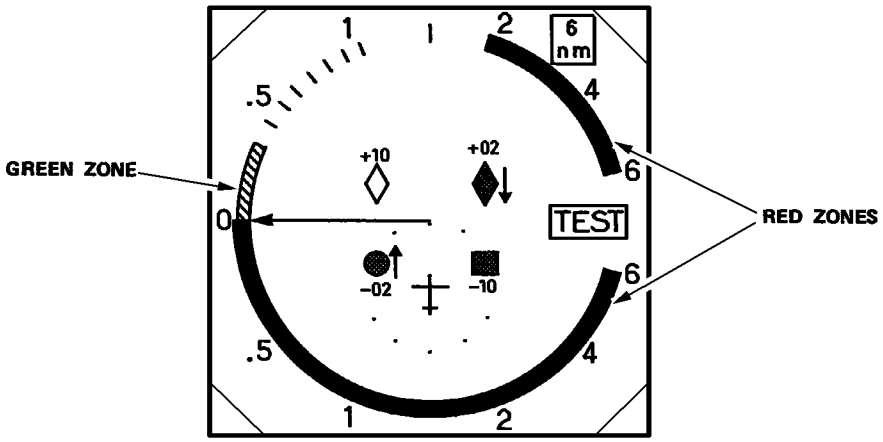
**ON A/C 005-200,

B. Failure Annunciation
At the end of the test sequence the system generates a synthetic voice message :
"TCAS SYSTEM TEST OK"
if the system is "OK", or :
"TCAS SYSTEM TEST FAIL"
if an anomaly has been detected.
In this case, the test results display shows "FAIL" instead of "OK" opposite the failed equipment.
In addition, two windows on the front of the TCAS computer display a code identifying the failed equipment according to the table below :

CODE	EQUIPMENT
TP	TCAS PROCESSOR
A#	TOP ANTENNA
B#	BOTTOM ANTENNA
X1	MODE S TRANSPONDER 1
X2	MODE S TRANSPONDER 2
RA	RADIO ALTIMETER 1 AND 2
PT	PITCH ATTITUDE DATA
RL	ROLL ATTITUDE DATA
HD	HEADING DATA
RD	RA DISPLAY 1 AND 2
PP	PROGRAM PINS

C. Extended Test Sequence
If the test button is held pressed in for longer than nine seconds the extended test sequence is initiated and will run as long as the button is pressed.
The VSI/TCAS indicator displays the part number software for 5 seconds and then the test results display with FAIL for failed equipment and OK for the others.

D. TCAS Frame on TCAS-DISP ARINC 429 Bus
For more in-depth checks, validity of the information transmitted by the TCAS computer to the indicators must be checked by connecting an ARINC 429 bus tester to the TCAS-DISP high speed buses linking the TCAS computer to the VSI/TCAS indicators.
The labels transmitted on this bus come from various sources :
- labels generated by the TCAS computer
- labels from the control unit and passing successively through the transponder and the TCAS computer



BM5 34 44 00 0 BEQ0 00

TCAS - Self Test Pattern
Figure 035

- labels received and re-issued by the transponders and passing through the TCAS computer.

Label Parameters
Table 1

LABEL	BITS	PARAMETER	SOURCE	DATA RATE MIN	DATA RATE MAX
013	9-10	Destination displays	Control unit via transponder	100 ms	200 ms
	11	Intruder altitude type - Relative/Absolute			
	12-13	Altitude surveillance zone			
	14	All traffic/threat traffic selection			
	15-21	Spare			
	22-29	TCAS range (NM)			
015	9-10	Destination displays	Control unit via transponder	300 ms	500 ms
	11-17	Altitude zone A value			
	18-24	Altitude zone B value			
	25-29	Spare			
016	9-10	Destination displays	Control unit via transponder	100 ms	200 ms
	11	"Altitude reporting" selection			
	12	"Ident" p/b active (control panel)			
	13-14	Display functions			
	15-17	TCAS operating mode on CTL PNL			
	18-29	Mode A identification code			
203	9-10	SDI	ADC via transponder	31.3ms	500 ms
	11-29	Standard barometric altitude			
270	9-10	SDI	TCAS computer	300 ms	500 ms
	11-17	Vertical speed value (RA)			
	18-29	Advisory type definition			
274	9-22	Spare	TCAS computer	300 ms	500 ms
	23-25	Sensitivity level SL field			
	26-29	Sensitivity level RI field			
350	9-10	SDI	TCAS computer	500 ms	1000 ms
	11	1 = TCAS failure			
	12	1 = TCAS top antenna failure			
	13	1 = TCAS bottom antenna failure			
	14	1 = Radio Alti 1 bus inactive			
	15	1 = Radio Alti 2 bus inactive			
	16	1 = Transponder 1 inactive or failed			
	17	1 = Tranponder 2 inactive or failed			
	18	1 = Altitude bus inactive			
	19	1 = Magnetic heading bus inactive			

LABEL	BITS	PARAMETER	SOURCE	DATA RATE MIN	DATA RATE MAX
	20	1 = TCAS system failure			
	21	1 = Spare			
	22	1 = Spare			
	23	1 = VSI/TCAS 1 failure RA function			
	24	1 = VSI/TCAS 2 failure RA function			
	25	1 = VSI/TCAS 1 failure RA function			
	26	1 = VSI/TCAS 2 failure RA function			
	27	1 = CFDIU bus inactive			
	28	1 = BITE test inhibition			
	29	1 = Command word acknowledgement			

Table 2

LABEL	BITS	PARAMETER	SOURCE	DATA RATE MIN	DATA RATE MAX
356	9-31	Message text characters	TCAS computer	100 ms	3000 ms
357 /RTS	9-16	Number of words in intruder file	TCAS computer	twice/sec	
	17-18	Spare			
	19	TA/RA ONLY or ALL TRAFFIC display			
	20-24	Number of displayed intruders programming			
	25-31	DC2 character			
357 /BTX	9-16	Number of words in intruder file	TCAS computer	twice/sec	
	17-24	Spare			
	25-31	ETX character			
130	9-10	SDI bits set to 0	TCAS computer	twice/sec	
	11-15	Intruder number			
	16-18	Intruder sensitivity level			
	19-29	Intruder range			
131	9-10	SDI bits set to 0	TCAS computer	twice/sec	
	11-15	Intruder number			
	16-19	Spare			
	20-21	Intruder vertical speed sense			
	22-29	Intruder relative altitude			
132	9-10	SDI bits set to 0	TCAS computer	twice/sec	
	11-15	Intruder number			
	16-18	Intruder type			
	19-29	Bearing			

Labels 130, 131, 132, 203 are BNR with SSM :

b31	b30	Meaning
0	0	Failure Warning
0	1	No Computed Data
1	0	Functional Test
1	1	Normal Operation

Labels 013, 015, 016, 270, 274, 350 are DISC with SSM :

b31	b30	Meaning
0	0	Normal Operation
0	1	No Computed Data
1	0	Functional Test
1	1	Failure Warning

Labels 356 and 357 are ISO5 and have no SSM.

NOTE : - in the intruder files, each intruder is represented by a group formed of labels 130, 131 and 132, with each label containing the intruder number. The intruders representing the most serious threat are transmitted first and displayed in this order. Therefore the maximum number of displayed intruders limitation is applied to the less threatening intruders
- an intruder file always starts with the label 357/RTS and ends with the label 357/ETX. If no intruder is detected, the transmitted file is empty, but the 357 labels are still transmitted
- the maintenance messages are transmitted by a series of 356 labels. Each label includes three ISO5 characters. The first label indicates the number of words in the message and contains the character STX. The last label contains the character EOT.

**ON A/C 005-100,

1. Operational Test

A. Reason for the Job
To make certain that the TCAS Computer is operating correctly using BITE test.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit-3-phase, 115/200 V, 400 Hz
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-25-00, P. Block 501	IRS

C. Procedure
(1)Job set-up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Align the IRS (Ref. 34-25-00, P. Block 501).
(d)Make certain that the following circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAV/ADS-F/O ALTM & VSI	24FL2	105/E11
21VU	NAV-TCAS	4SG	104/F07
21VU	RADIO NAV & COM-ATC1	3SH1	107/C01
21VU	RADIO NAV & COM-ATC2	3SH2	107/C14
22VU	NAV/ADS-CAPT ALTM & VSI	24FL1	204/F18

(e)Check that circuit breakers, particularly those associated with NAVIGATION, EFIS, RADIO/NAV & COM and ECAM are closed.
(f)Make certain that both VSI/TCAS indicators are operating and adjust brightness by potentiometers located on panels 419 and 420VU.
(g)On PFDs, make certain that Radio Altitude is displayed.
(h)Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (aircraft in ground configuration).

R (2)Test the System
NOTE : TCAS can be tested from the flight compartment or the avionics compartment. The test described below uses ATC1 system. Information shown in brackets concerns ATC2 system.

**ON A/C 101-200,

1. Operational Test

A. Reason for the Job
To make certain that the TCAS Computer is operating correctly using BITE test.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit-3-phase, 115/200 V, 400 Hz
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-25-00, P. Block 501	IRS

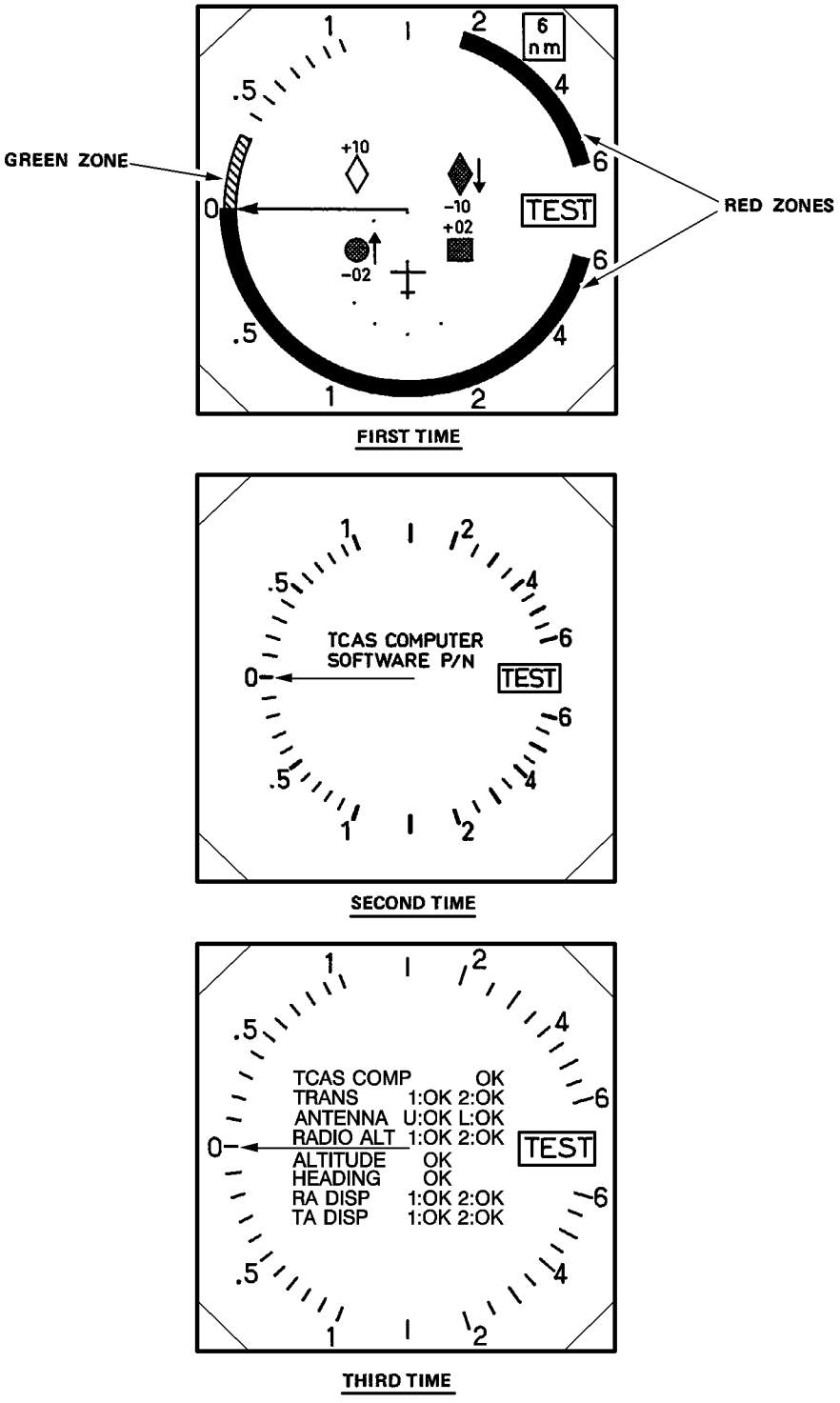
C. Procedure
(1)Job set-up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Align the IRS (Ref. 34-25-00, P. Block 501).
(d)Make certain that the following circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAV/ADS-F/O ALTM & VSI	24FL2	105/E11
21VU	NAV-TCAS	4SG	104/F07
21VU	RADIO NAV & COM-ATC1	3SH1	107/C01
21VU	RADIO NAV & COM-ATC2	3SH2	107/C14
22VU	NAV/ADS-CAPT ALTM & VSI	24FL1	204/F18

(e)Check that circuit breakers, particularly those associated with NAVIGATION, EFIS, RADIO/NAV & COM and ECAM are closed.
(f)Make certain that RA/VSI and TA display indicators are operating and adjust brightness by potentiometers located on panels 419 and 420VU for the RA/VSI indicators.
(g)On PFDs, make certain that Radio Altitude is displayed.
(h)Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (aircraft in ground configuration).
NOTE : TCAS can be tested from the flight compartment or the avionics compartment. The test described below uses ATC1 system. Information shown in brackets concerns ATC2 system.
(Ref. Fig. 501)

**ON A/C 005-100,

(Ref. Fig. 502)
(a)From flight compartment :



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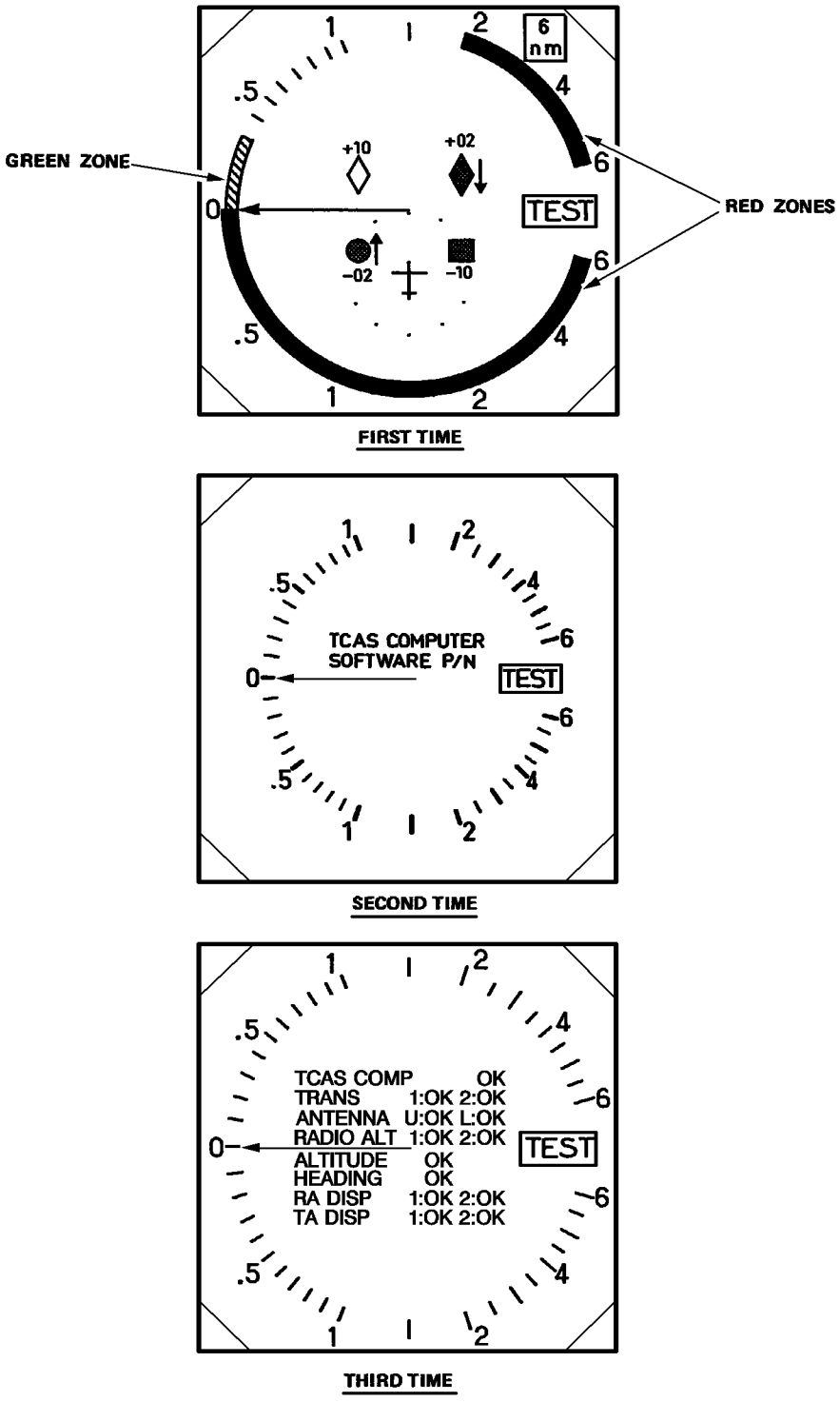
TCAS - Test Display on VSI/TCAS Indicator
Figure 501



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TCAS - Test Display on VSI/TCAS Indicator
Figure 502

ACTION	RESULT
1. On ATC/TCAS control unit - place ATC 1/2 switch in position 1(2) - place ALT 1/2 switch in position 1(2) - place TEST/STBY/ALT OFF/ ALT ON/TA/TA/RA switch in TA/RA position - display own aircraft code	The code is displayed in the window.
2. On panel 21VU - open circuit breaker 4SG - close circuit breaker 4SG	On CAPT and F/O VSI/TCAS indicators RA FAIL and TCAS FAIL flags appear RA FAIL and TCAS FAIL flags disappear.

**ON A/C 101-200,

(a)From flight compartment :

ACTION	RESULT
1. On ATC/TCAS control unit - place ATC 1/2 switch in position 1(2) - place TEST/STBY/ALT OFF/ ALT ON/TA/TA/RA switch in TA/RA position - display own aircraft code	The code is displayed in the window.
2. On panel 21VU - open circuit breaker 4SG - close circuit breaker 4SG	On CAPT and F/O VSI/TCAS indicators RA FAIL and TCAS FAIL flags appear RA FAIL and TCAS FAIL flags disappear.

**ON A/C 005-100,

3. On center pedestal 11VU, on ATC/TCAS control unit. - place TEST/STBY/ALT OFF/ALT ON/TA/TA/RA selector switch in TEST position	On CAPT and F/O ATC/TCAS control unit : - ATC FAIL light comes on, then goes off.

**ON A/C 101-200,

3. On center pedestal 11VU, on	On CAPT and F/O ATC/TCAS control

ACTION	RESULT
ATC/TCAS control unit. - place TEST/STBY/ALT OFF/ALT ON/TA/TA/RA selector switch in TEST position Or on panel 470VU - press and hold AVIONICS SYS TEST/ATC/TCAS pushbutton switch	unit : - ATC FAIL light comes on, then goes off.
**ON A/C 005-200,	
	In a first time : On CAPT and F/O VSI/TCAS indicators : - a RA appears : . Range : 2 NM about . Bearing : 3 hours . Relative altitude : -10 (1000 ft.) . Trend : No arrow. - a TA appears : . Range : 2 NM about . Bearing : 9 hours . Relative altitude : -02 (200 ft.) . Trend : arrow climbing - a PROXIMATE appears : . Range : 3.6 NM about . Bearing : 1 hour . Relative altitude : +02 (200 ft.) . Trend : arrow descending - an OTHER appears : . Range : 3.6NM about . Bearing : 11 hours . Relative altitude : +10 (1000 ft.) . Trend : No arrow. - TEST flag appears in the window located on the center right of the dial. - A red arc is displayed along the vertical speed scale except from 0 to 2000 ft./mn. A green arc is displayed from 0 to 300 ft./mn. In a second time : On TCAS Computer, check that the two digits come on in the fault annunciator window. On CAPT and F/O VSI/TCAS indica-

ACTION	RESULT
	tors : - All symbols disappear, as well as the red and green arcs on the scale. - Message is displayed **TCAS COMPUTER** **SOFTWARE P/N.** In a third time : On **CAPT** and **F/O VSI/TCAS** indicators : Last message is replaced by : **TCAS OK** **TRANSP 1 : OK 2 : OK** **ANTENNA U : OK L : OK** **RADIO ALT 1 : OK 2 : OK** **ATTITUDE OK** **HEADING OK** **RA DISP 1 : OK 2 : OK** **TA DISP 1 : OK 2 : OK** **NOTE** : If one system is faulty, **OK** is replaced by **FAIL.** At the end of the test : An aural message **"TCAS SYSTEM TEST OK"** sounds. **NOTE** : If one system is faulty, the message becomes **"TCAS SYSTEM TEST FAIL".**

(b)From avionics compartment

**ON A/C 005-100,

ACTION	RESULT
1. On **ATC/TCAS** control unit - place **ATC 1/2** switch in position 1(2) - place **ALT 1/2** switch in position 1(2) - place **TEST/STBY/ALT OFF/ALT ON/TA/TA/RA** switch in **TA/RA** position - display own aircraft code	The code is displayed in the window.

**ON A/C 101-200,

ACTION	RESULT
1. On ATC/TCAS control unit - place ATC 1/2 switch in position 1(2) - place TEST/STBY/ALT OFF/ALT ON/TA/TA/RA switch in TA/RA position - display own aircraft code	The code is displayed in the window.

**ON A/C 005-200,

2. On panel 21VU - open circuit breaker 4SG - close circuit breaker 4SG	On CAPT and F/O VSI/TCAS indicators RA FAIL and TCAS FAIL flags appear RA FAIL and TCAS FAIL flags disappear.
3. In Avionics Compartment ; on 500VU rack : - press and hold TCAS TEST pushbutton switch located on TCAS computer face.	In a first time : On CAPT and F/O VSI/TCAS indicators : - a RA appears : . Range : 2 NM about . Bearing : 3 hours . Relative altitude : -10 (1000 ft.) . Trend : No arrow - a TA appears : . Range : 2 NM about . Bearing : 9 hours . Relative altitude : -02 (200 ft.) . Trend : arrow climbing - a PROXIMATE appears : . Range : 3.6 NM about . Bearing : 1 hour . Relative altitude : +02 (200 ft.) . Trend : arrow descending - an OTHER appears : . Range : 3.6 NM about . Bearing : 11 hours . Relative altitude : +10 (1000 ft.) . Trend : No arrow - TEST flag appears in the window located on the center right of the dial. - A red arc is displayed along the vertical speed scale except from 0 to +2.000 ft./mn.

ACTION	RESULT
	A green arc is displayed from 0 to 300 ft./mn. In a second time : On TCAS computer face, check that the two digits come on in the fault annunciator window. On CAPT and F/O VSI/TCAS indicators : - All symbols disappear, as well as the red and green arcs on the scale. - Message is displayed TCAS COMPUTER SOFTWARE P/N. On TCAS computer : OK is displayed in two digit fault annunciator window. NOTE : If one system is faulty OK is replaced by a two-digit failure code in the fault annunciator window (Ref. 34-44-00, P. Block 1, Para. 6.B.). In a third time : On CAPT and F/O VSI/TCAS indicators : Last message is replaced by : TCAS OK TRANSP 1 : OK 2 : OK ANTENNA U : OK L : OK RADIO ALT 1 : OK 2 : OK ATTITUDE OK HEADING OK RA DISP 1 : OK 2 : OK TA DISP 1 : OK 2 : OK NOTE : If one system is faulty, OK is replaced by FAIL. At the end of the test : An aural message "TCAS SYSTEM TEST OK" sounds. NOTE : If one system is faulty, the message becomes "TCAS SYSTEM TEST FAIL".

(3)Close-up
(a)On ATC/TCAS control unit, restore system to normal operating condition.
(b)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(c)Restore system and aircraft to normal operating condition.

R

MMEL 34-76-01 (FAA only)

1. TCAS Deactivation

A. Reason for the Job
Ref. MMEL 34-76-01 (FAA only)

B. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	INOP Sticker
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-44-00, P. Block 501	Operational Test of the TCAS System

C. Procedure
(1)Job set-up
(a)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make sure that these circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAV/ADS-F/O ALTM & VSI	24FL2	105/E11
21VU	NAV-TCAS	4SG	104/F07
21VU	RADIO NAV & COM-ATC1	3SH1	107/C01
21VU	RADIO NAV & COM-ATC2	3SH2	107/C14
22VU	NAV/ADS-CAPT ALTM & VSI	24FL1	204/F18

(2)Procedure
(a)Do the operational test of the TCAS system (Ref. 34-44-00, P. Block 501).
If the test gives a maintenance message :
1 Open, safety and tag circuit breaker 4SG.
2 On ATC/TCAS control unit, put an INOP sticker to mask TCAS function.

2. TCAS Reactivation

A. Reason for the Job

B. Equipment and Materials

ITEM	DESIGNATION
Referenced Procedure	
- 24-41-00, P. Block 301	AC External Power Control
TSM 34-44-00	For Corrective action

C. Procedure

(1)Job set-up

(a)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(b)Make sure that these circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAV/ADS/F/O ALTM & VSI	24FL2	105/E11
21VU	RADIO NAV & COM-ATC1	3SH1	107/C01
21VU	RADIO NAV & COM-ATC2	3SH2	107/C14
22VU	NAV/ADS-CAPT ALTM & VSI	24FL1	204/F18

(2)Procedure

(a)Close this circuit breaker :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAV-TCAS	4SG	104/F07

(b)On ATC/TCAS control unit, remove INOP sticker.

(c)Perform the trouble-shooting procedure (Ref. TSM 34-44-00).

D. Close-up

(1)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

TCAS ANTENNA - REMOVAL/INSTALLATION

WARNING : USE SOLVENTS/CLEANING AGENTS, SEALANTS AND OTHER SPECIAL MATERIALS
ONLY IN A WELL VENTILATED AREA.
OBEY THE MANUFACTURER'S INSTRUCTIONS.
PUT ON PROTECTIVE CLOTHES.
DO NOT GET THEM IN YOUR MOUTH.
DO NOT SMOKE.
DO NOT INHALE THE GAS.
THESE MATERIALS ARE POISONOUS AND FLAMMABLE AND SKIN IRRITANTS.
GET MEDICAL HELP IF YOUR SKIN OR EYES BECOME IRRITATED.

NOTE : The removal/installation procedure is the same for TCAS antennas 7SG1 and 7SG3.

1. Equipment and Materials

	ITEM	DESIGNATION
R	A.	Access Platform 7.90 m (26 ft.)
R	B.	Corrosion-Resistant Steel Lockwire 0.4 mm (0.016 in.) dia.
R	C.	Lint-free Cloth
R	D.	Nonmetallic Scraper
R	E.	Nylon Yarn
R	F.	O-Ring
R	G.	Blanking Caps
R	H. Material No. 09-016	Sealants (Ref. 20-31-00)
R	J. Material No. 11-026	Cleaning Agents (Ref. 20-31-00)
R	K. Material No. 16-003	Structure Paints (Ref. 20-31-00)

NOTE : For access to top mounted TCAS antenna use access platform.

Referenced Procedure
- 34-44-00, P. Block 501 TCAS

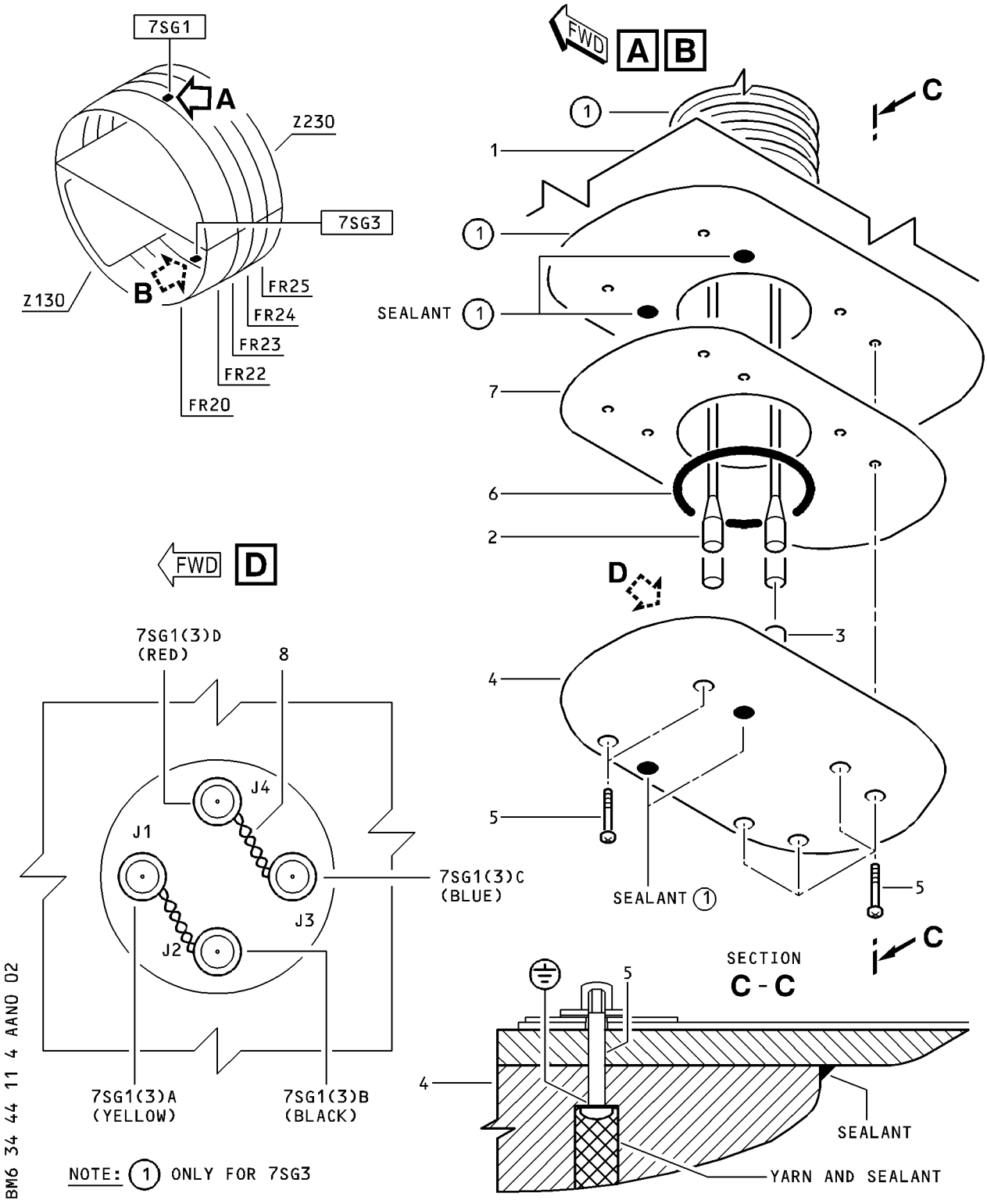
2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breaker:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RAD NAV & COM/TCAS	4SG	

(Ref. Fig. 401)

B. Removal
(1)Remove the sealant and the yarn or the mixture of sealant and yarn from the recesses of the screws (5).
(2)Remove the screws (5).
(3)Pull the antenna (4) carefully away.



TCAS Antenna
Figure 401

(4)Remove and discard the lockwire (8) from the coaxial connectors (2).
(5)Disconnect the coaxial connectors (2) from the TCAS antenna connectors (3).
NOTE : Make sure that the coaxial connectors (2) do not go back into the fuselage.
(6)Remove the antenna (4) and the gasket (7).
(7)Put blanking caps on the disconnected coaxial connectors (2) and the TCAS antenna connectors (3).
(8)Remove and discard the O-ring (6).

C. Installation
(1)Remove the used sealant from the fuselage structure (1) with a non-metallic scraper.
WARNINTG : CLEANING AGENT (MAT. NO. 11-026) IS DANGEROUS.
(2)Clean the component interface and/or the adjacent area with CLEANING AGENTS (MAT. NO. 11-026) and a lint free cloth.
(3)Do a visual inspection of the component interface and/or the adjacent area.
NOTE : Make sure that the antenna-attachment screw-head recesses have no signs of paint, corrosion or sealant because the antenna bonding is made through the attachment screws.
(4)Install the new O-ring (6).
(5)Align the gasket (7) on the fuselage with the screw holes.
(6)Remove the blanking caps from the coaxial connectors (2) and the TCAS antenna connectors (3).
(7)Connect the coaxial connectors (2) to the TCAS antenna connectors (3) to agree with detail C.
(8)Safety the coaxial connectors (2) with corrosion-resistant steel lockwire 0.4 mm (0.016 in.) dia. (8).
(9)Put the antenna (4) in position and install the screws (5).
(10)Tighten the screws (5) in a diagonal sequence.
(11)Make sure that the bonding contact resistance between the antenna (4) and the fuselage structure (1) is not higher than 5 milliohms.
(12)Make a sealing bead with SEALANTS (MAT. NO. 09-016) around the antenna (4).
(13)Fill the recesses of the screws (5) with the nylon yarn followed by the SEALANTS (MAT. NO. 09-016), or with a mixture of nylon yarn and SEALANTS (MAT. NO. 09-016).
(14)Make the contour of the sealant on the screws (5) and around the antenna (4) smooth.
(15)Let the sealant cure.
(16)Apply STRUCTURE PAINTS (MAT. NO. 16-003) to the sealant around the antenna and the screw heads.
R NOTE : It is not mandatory to paint the sealant around the base of the
R antenna and on the head of the screws.

D. Test
(1)Carry out TCAS operational test (Ref. 34-44-00, P. Block 501).

E. Close-Up
(1)Make sure that the working area is clean and clear of tools and

miscellaneous items of equipment.

R

1. Equipment and Materials

ITEM	DESIGNATION
A.	Blanking Plugs/Caps
B.	Circuit Breaker Safety Clips
Referenced Procedure - 34-44-00, P. Block 501	TCAS

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breaker for TCAS computer 1SG :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAV-TCAS	4SG	104/F07

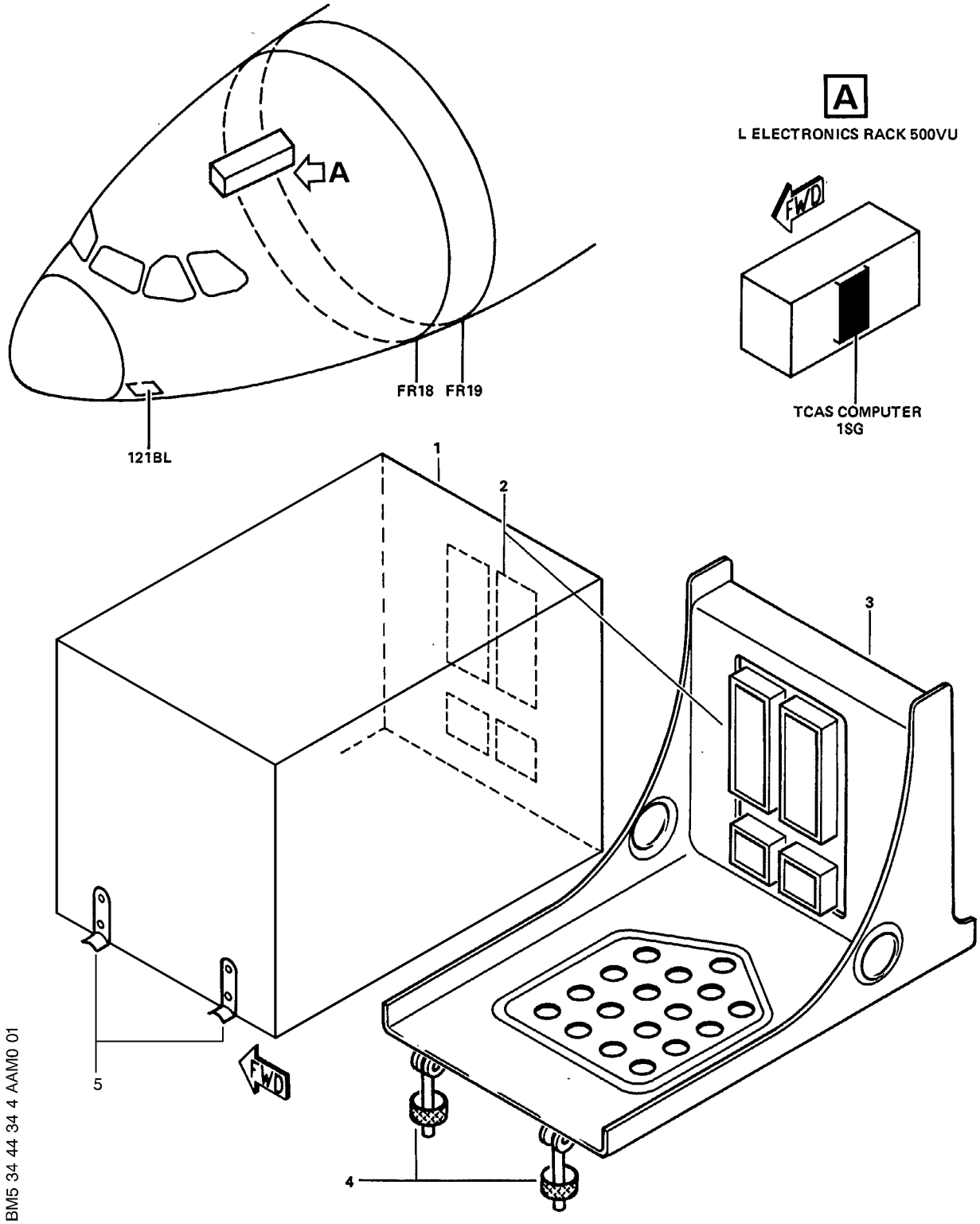
(2)Open access door 121BL to gain access to avionics compartment. (Ref. Fig. 401)

B. Removal
(1)Unscrew knurled nuts on tenons (5). Tilt tenons (5) downwards to disengage them from studs (4).
(2)Pull the TCAS computer (1) on its rack (3) to disconnect the electrical connectors (2).
(3)Remove TCAS computer (1) from its rack (3).
(4)Blank electrical connectors (2).

C. Installation
(1)Clean and inspect TCAS computer interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (2). Make certain that connectors are clean and in correct condition.
(3)Install TCAS computer (1) on its rack (3).
(4)Push the TCAS computer (1) on its rack (3) to connect the electrical connectors (2).
(5)Tilt tenons (5) upwards and lift knurled nuts into position on studs (4). Tighten.
(6)Remove safety clip and tag and close circuit breaker 4SG.

D. Test
Carry-out operational test of TCAS computer (Ref. 34-44-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.



TCAS - Computer
Figure 401

(3)Restore system and aircraft to normal operating condition.

GROUND PROXIMITY WARNING SYSTEM - DESCRIPTION AND OPERATION

1. General

The ground proximity warning system (GPWS) generates aural and visual warnings if the aircraft adopts a potentially hazardous condition with respect to:

- Excessive rate of descent
- Excessive closure rate with terrain
- Loss of height after take-off
- Insufficient terrain clearance
- Descent below glideslope

The system is operative between 30 ft. and 2450 ft. radio altitude.

Two switches, the captains and the first officers GPWS-G/S pushbutton switches have a dual function:

- Above 30 ft. and below 1000 ft. radio altitude the switch can be used to cancel a G/S warning (mode 5)
- Above 1000 ft and below 30 ft switches are used to initiate GPWC self-test (refer to paragraph 5C).

The Ground Proximity Warning Computer (GPWC) is the major part of the GPWS.

The primary functions of the computer are:

- Receiving and processing of serial digital and discrete data for use in computing warning mode conditions.
- Warning mode computations to determine when the aircraft penetrates one of the warning boundaries mentioned above.
- Output warnings and control - audible and visible indications when a mode computation reveals a boundary penetration.
- Monitoring and indicating of the GPWS status as well as internal monitoring of the GPWC. The computer stores failures for later readout on a front panel BITE display.

All controls and indicators (audible and visible) of the GPWS are installed in the cockpit.

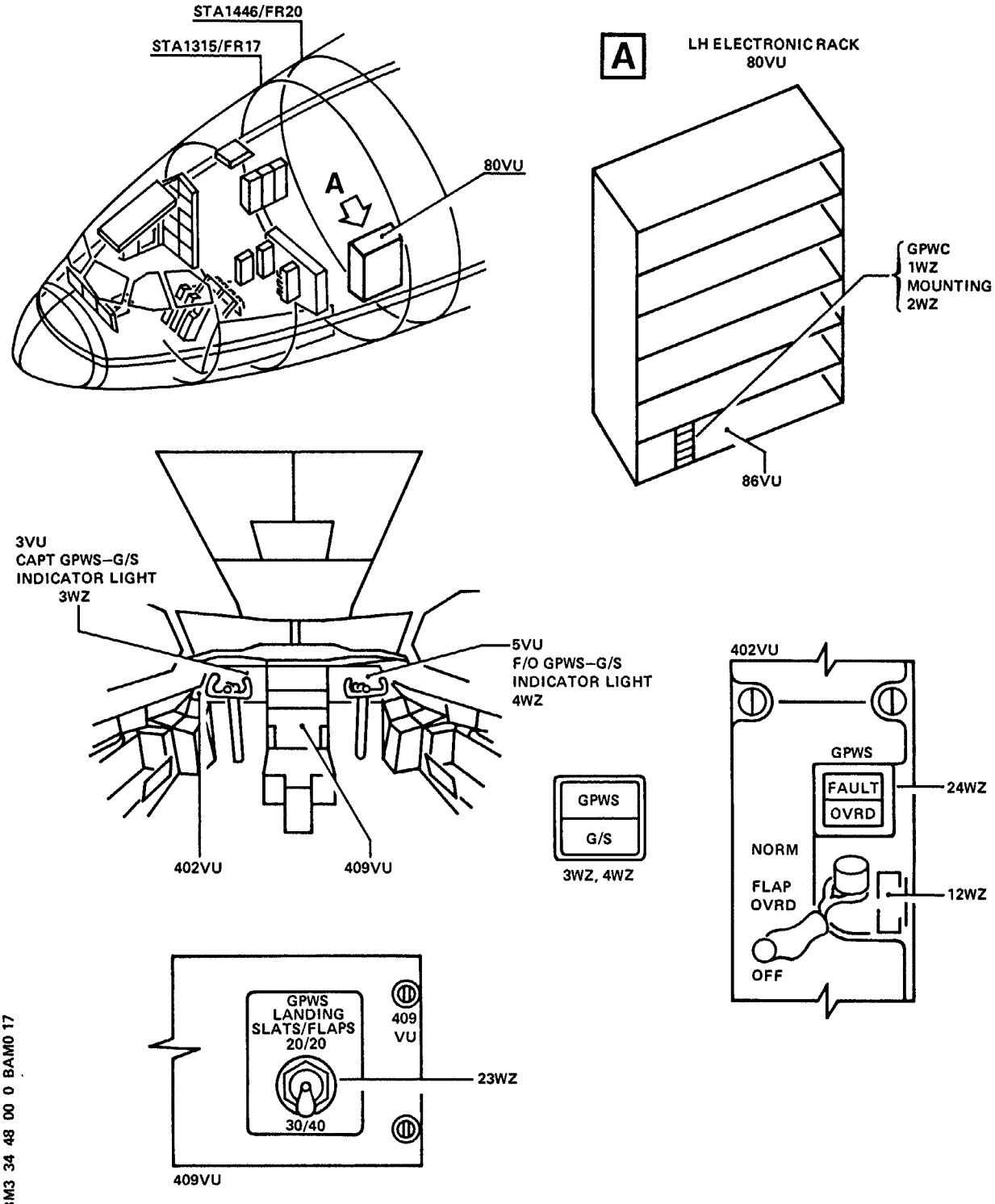
2. Component Location

(Ref. Fig. 001)

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF
1WZ	COMPUTER-GROUND PROXIMITY WARNING	86VU	121		
2WZ	MOUNT-GPWC	86VU	121		
3WZ	INDICATOR LIGHT-GPWS/G/S	3VU	211		
4WZ	INDICATOR LIGHT-GPWS/G/S	5VU	212		
12WZ	SWITCH-NORM/FLAP OVRD/OFF	402VU	212		
23WZ	SWITCH-GPWS/LANDING/SLATS/FLAPS	409VU	212		
24WZ	ANNUNCIATOR-GPWS	402VU	212		

3. Description

A. The GPWS monitors data inputs from navigation sensors. This information is used to provide suitable aural and visual warnings to alert the crew of insufficient terrain clearance or excessive descent rate.



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Component Location
Figure 001

B. Warnings are generated by the GPWC which is installed in the electronics compartment. Aural warnings are broadcast from the flight compartment loudspeakers. Visual warnings are provided by GPWS-G/S indicator lights mounted on the captain's and first officer's main instrument panel.

C. A NORM/FLAP OVRD/OFF switch, located on the captain's switching panel, allows for abnormal configuration during take-off and approach and also provides a facility to inhibit system operation.

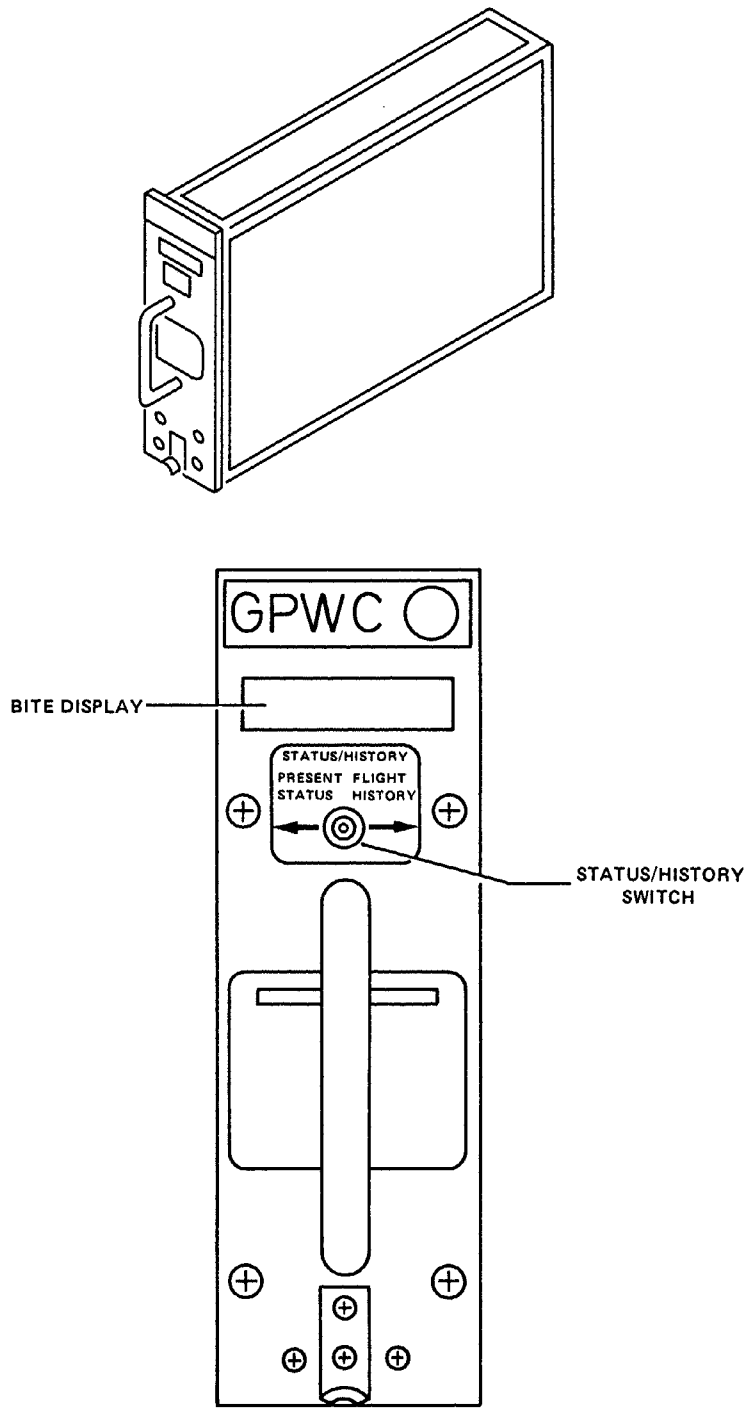
D. A GPWS annunciator, located on the captain's switching panel, indicates system failure.

E. A GPWS/LANDING/SLATS/FLAPS switch located on panel 409VU, allows a flaps landing position selection of 20 or 40 degrees during approach or landing. The switch makes certain that the flap discrete signal from the Slat Flap Control Computer (SFCC) to the GPWC is provided either in 20 or 40 degrees flaps position.

4. Component Description
(Ref. Fig. 002)

A. Ground Proximity Warning Computer (1WZ)
(1)Description
(a)The GPWC comprises an ARINC 600-2MCU case, housing interfacing, computing and warning output circuits.
(b)The front panel contains a STATUS/HISTORY test switch and associated 8-character, alpha-numeric BITE display. If the STATUS/HISTORY switch is momentarily set to PRESENT STATUS, the BITE display provides a sequential readout of system operational status. If the STATUS/HISTORY switch is momentarily set to FLIGHT HISTORY, the BITE display provides a sequential readout of system failures stored from the previous 10 flights.
(c)The rear panel contains an ARINC 600, shell size/connector to provide electrical connections to the aircraft wiring via mounting tray 2WZ. Contact grouping is as follows:
Top contact set - ATE interface.
Center contact set - System interconnections
Bottom contact set - Power supply and bonding

(2)Operation
(Ref. Fig. 003)
(a)Input/output circuits
Four ARINC 429 receivers are incorporated in the input/output circuits.
Each receiver converts specified ARINC 429 format serial digital data to 32-bit parallel words for storage in a random access memory (RAM). Data is accessed from RAM and checked for updating by the processor/voice/memory circuit.
Discrete inputs to the GPWC are detected by ground sensing buffers and converted to a digital word.



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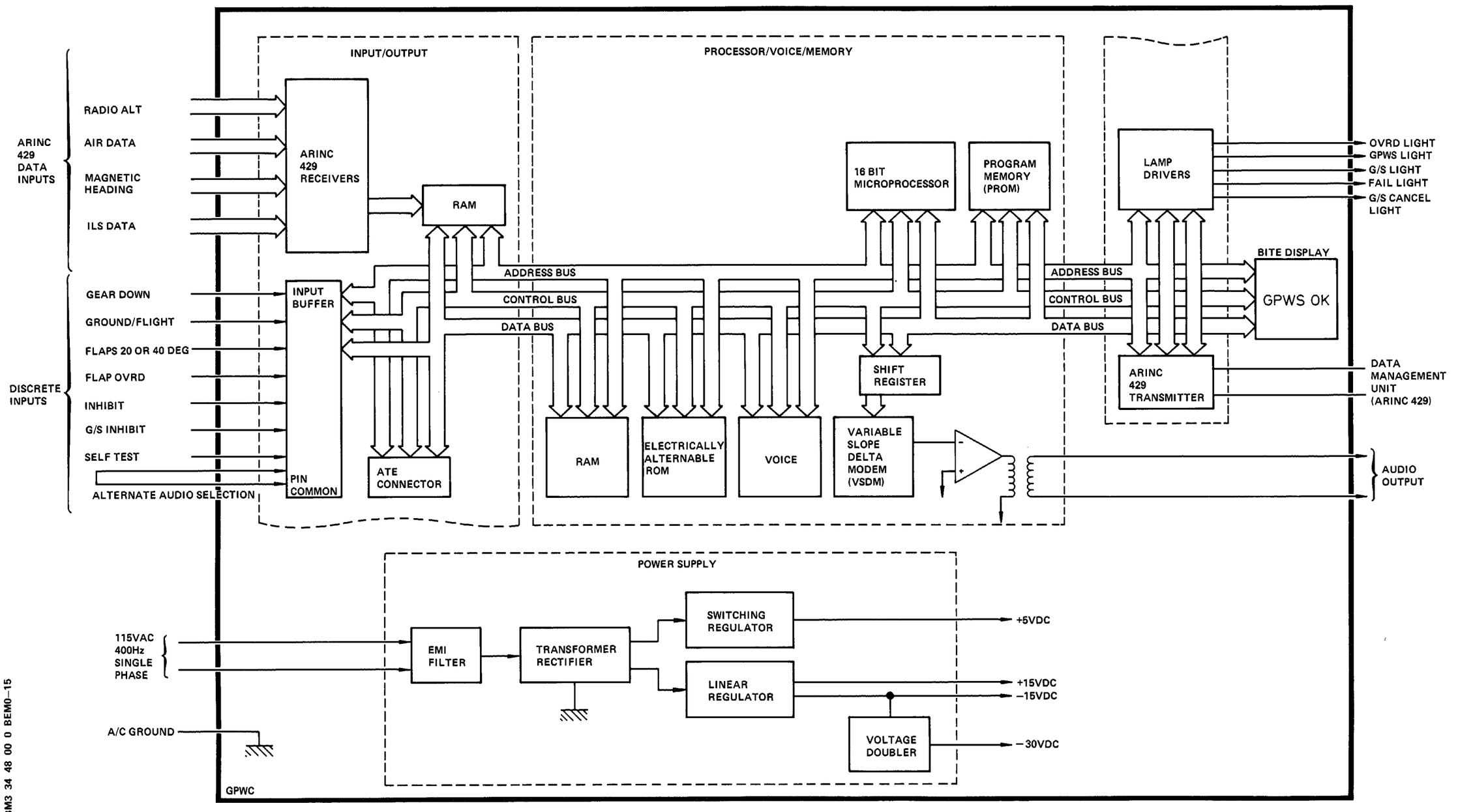
Ground Proximity Warning Computer
Figure 002



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GPWC Block Diagram
Figure 003

An ARINC 429 transmitter provides a GPWS output data word in ARINC 429 format (label 270 octal) for the data management unit in the aircraft integrated data system
Discrete outputs for the GPWS-G/S indicator lights and the GPWS FAULT indicator light are provided by over-voltage and reverse-voltage protected lamp drivers. The same discretes are send to the DFDAU of the AIDS.
Discrete output for the GPWS FAULT indicator light is provided by over-voltage and reverse voltage protected lamp driver.

(b) Processor/voice/memory
The processor/voice/memory consists of a 16-bit microprocessor (with associated timing and buffer circuits), program and voice memories, and a variable slope delta modem (to convert serial data to analog speech). The 16-bit microprocessor is driven by a 4 MHz clock and is monitored by a 'watchdog' timer. The 'watchdog' timer resets the processor in the event of an incomplete program iteration.
The aural warning messages reside in eight 32K bit read only memories (ROM). The vocabulary for the messages is defined by an alternate audio alert select No. 3 discrete input. When a message is required for a broadcast, the associated bits are converted from parallel to serial format and shifted into the variable-slope delta modem. The audio output is filtered, amplified and isolated to provide a suitable signal for the flight compartment speakers.
Data storage and scratchpad memory is achieved using four 2K-bit RAMs. Failure history data is stored in an electronically alterable ROM (EAROM) which is also used to store present flight characteristics data for use after momentary power losses. The program memory resides in four 32K-bit electronically reprogrammable ROMs (EPROMs). The EPROMS are ultra-violet light erasable.

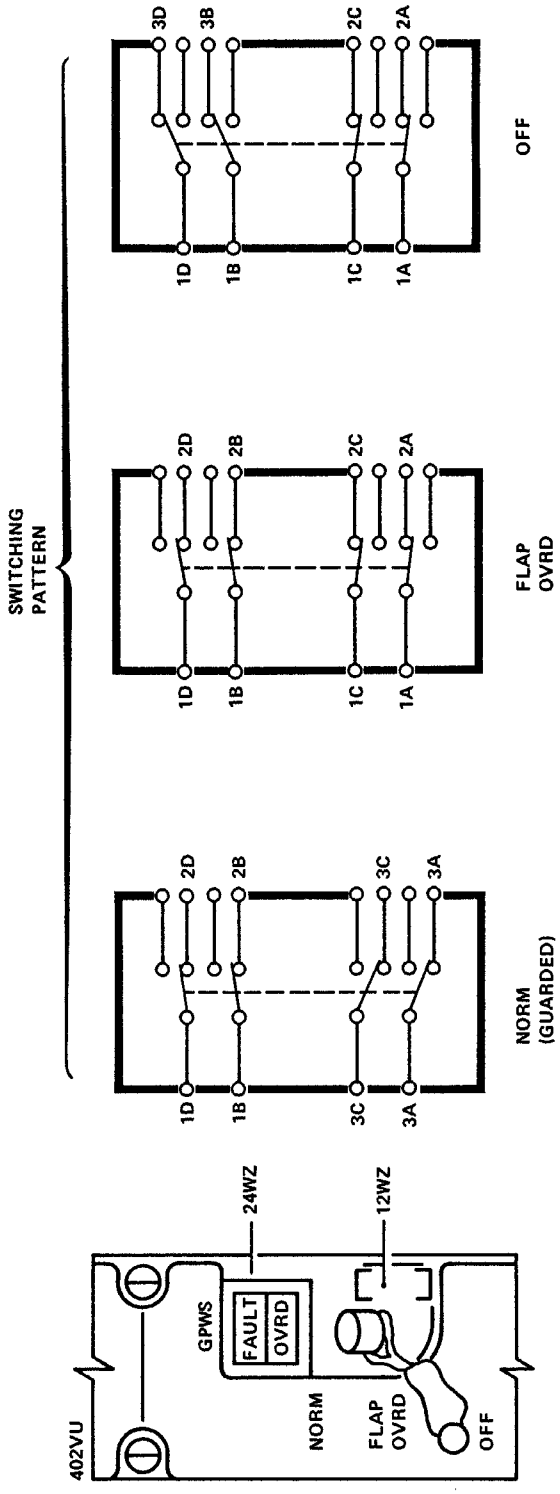
(c) Power supply
The GPWC power supply circuits receive 115VAC, 400Hz, single phase (20 W max) supply from the aircraft AC power supply and converts this supply to the following DC levels:
±15VDC from linear regulators with current limiting,
+5VDC from a compensated switching regulator with current limiting,
- 30VDC from a voltage doubler, fed by the 15VDC regulated supply.

B. GPWS-G/S Indicator Lights (3WZ, 4WZ)

(1) Indicator light 3WZ is located on the captain's main instrument panel, 3VU and indicator light 4WZ is located on the first officer's main instrument panel, 5VU.

(2) Each indicator light consists of a momentary contact pushbutton switch with a split-legend cap. The upper legend, GPWS, comes on when a ground proximity warning is generated by the GPWC. The lower legend, G/S, comes on when a glideslope advisory alert is generated by the GPWC.

(3) The pushbutton function provides a facility to cancel a glideslope warning (if in progress) or to initiate a GPWS self test (aircraft on ground or radio altitude greater than 1000 ft and airspeed greater than 90 knots). The test signal is also feed to the DFDAU of the AIDS.
(Ref. Fig. 004)



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NORM/FLAP OVRD/OFF Switch
Figure 004

C. NORM/FLAP OVRD/OFF Switch (12WZ)
(1)The GPWS NORM/FLAP OVRD/OFF switch is located on the captain's switching panel.
(2)The switch is a 3-position toggle switch, guarded in the NORM position to prevent inadvertent selection of FLAP OVRD or OFF.
(3)When NORM is selected, normal operation of the GPWC is assumed, whereby the 'flaps down' input (flaps at 20 or 40 degs.) is provided by slat flap control computers 1 and 2 (SFCC 1 and 2) - Ref. 27-55-00. When FLAP OVRD is selected, the switch supplies a 'flaps down' discrete to the GPWC, irrespective of flap surface position. The OVRD selection is indicated by lamp 24WZ (OVRD). When OFF is selected, all GPWS warnings, visual and aural, are inhibited and no self test is possible.
(Ref. Fig. 005)

D. GPWS Annunciator
(1)The GPWS annunciator, located on the pilot's switching panel, provides a FAULT warning indication that a system fault has been detected by the GPWC. Therefore, the computer applies a fault ground to the GPWS FAULT indicator.
If the FLAP OVERRIDE switch (12WZ) is set to the OVRD position, a ground is applied to the GPWS OVRD indicator which in turn provides the OVRD indication.
(2)When the FAULT caption comes on, all ground proximity warnings are inhibited and no self test is possible.

5. Operation
(Ref. Fig. 006)
(Ref. Fig. 007)
(Ref. Fig. 008) (Sheet 1/2)

**ON A/C 001-003,

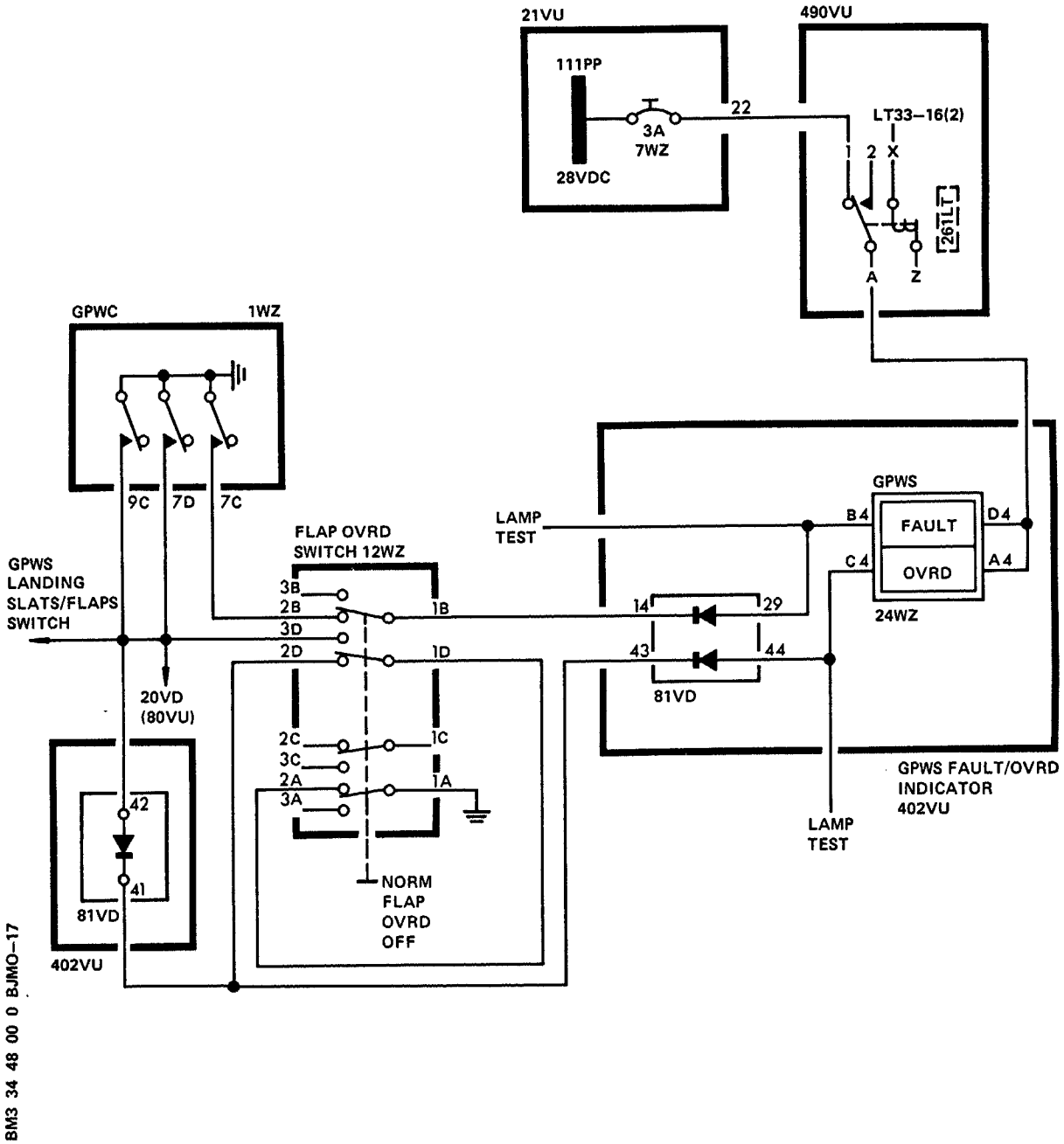
(Ref. Fig. 008) (Sheet 2 of 2)

R **ON A/C 004-100,

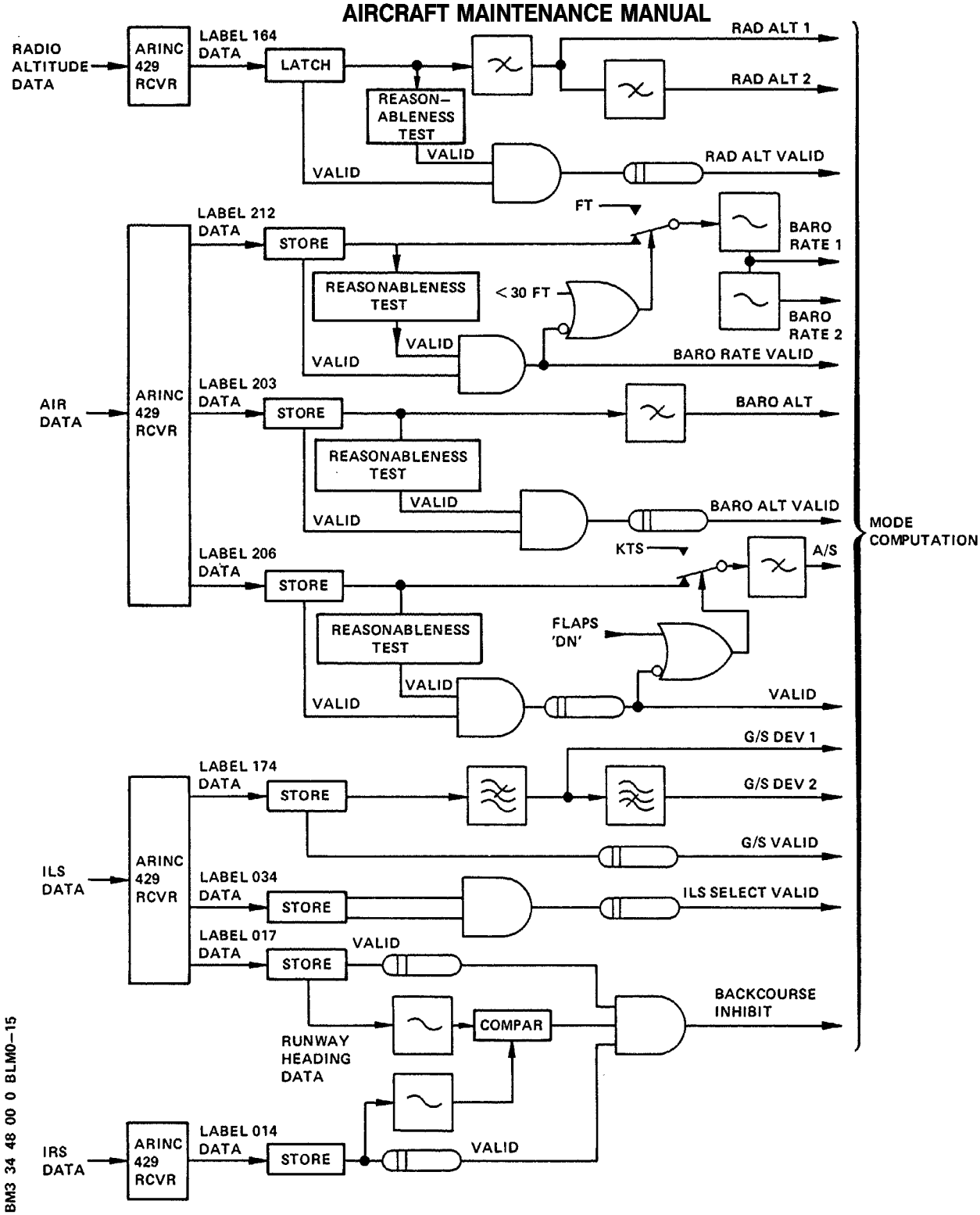
(Ref. Fig. 008) (Sheet 2 of 2)

R **ON A/C 001-004,

A. Overall System Operation
(1)The GPWC receives serial digital data inputs from the following:
- Radio altimeter transceiver 1 (Radio altitude)
- Digital air data computer 1 (barometric altitude, barometric altitude rate, computed airspeed).
- ILS receiver 1 (glideslope deviation, selected runway heading)
- Inertial reference system 1 (magnetic heading).
(2)Discrete data inputs are received from the following:
- Gear relays
- SFCC 1 and 2 (flaps at 20 or 40 degrees)



GPWS Annunciator
Figure 005



Input Signal Conditioning (Digital)
Figure 006

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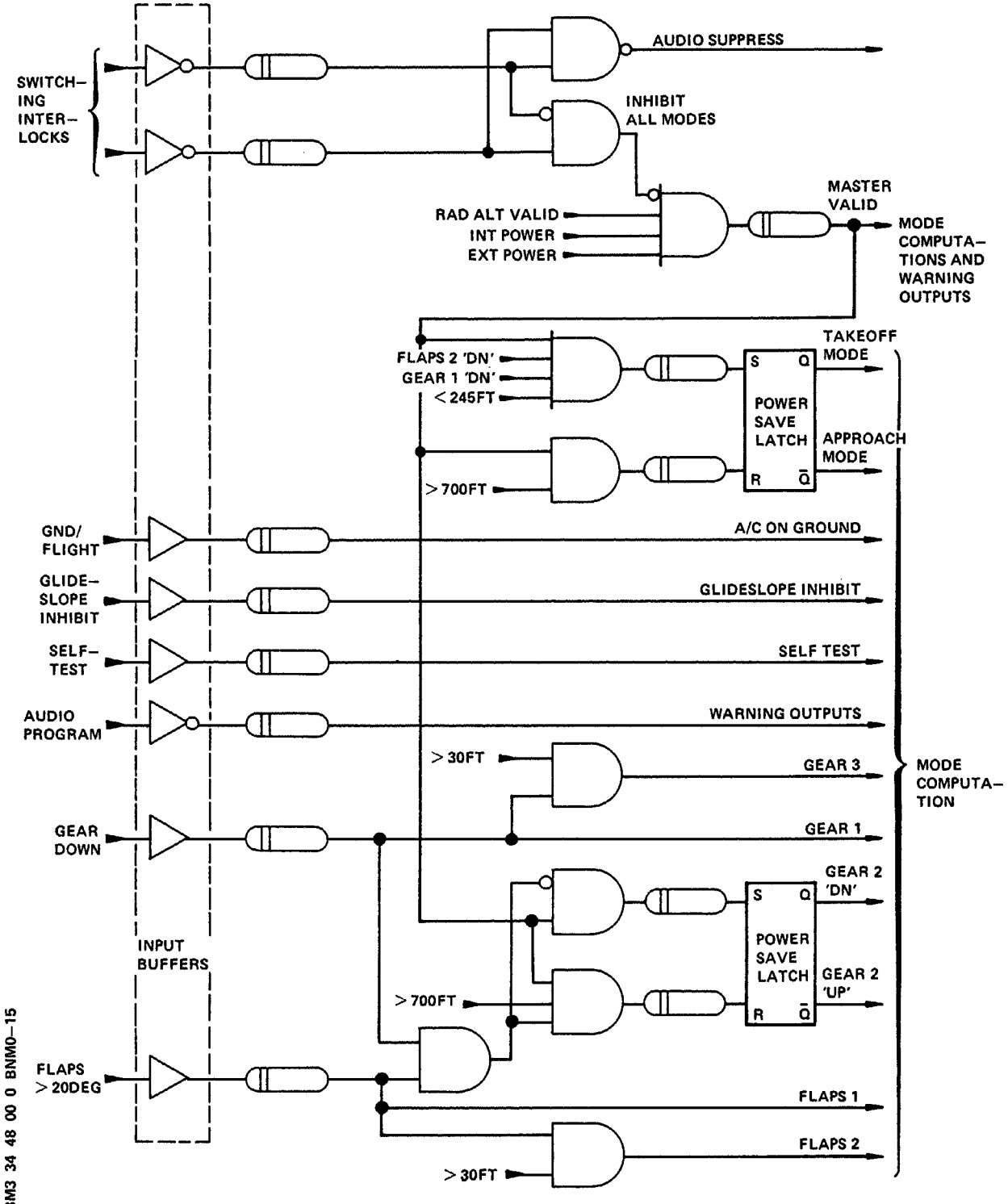
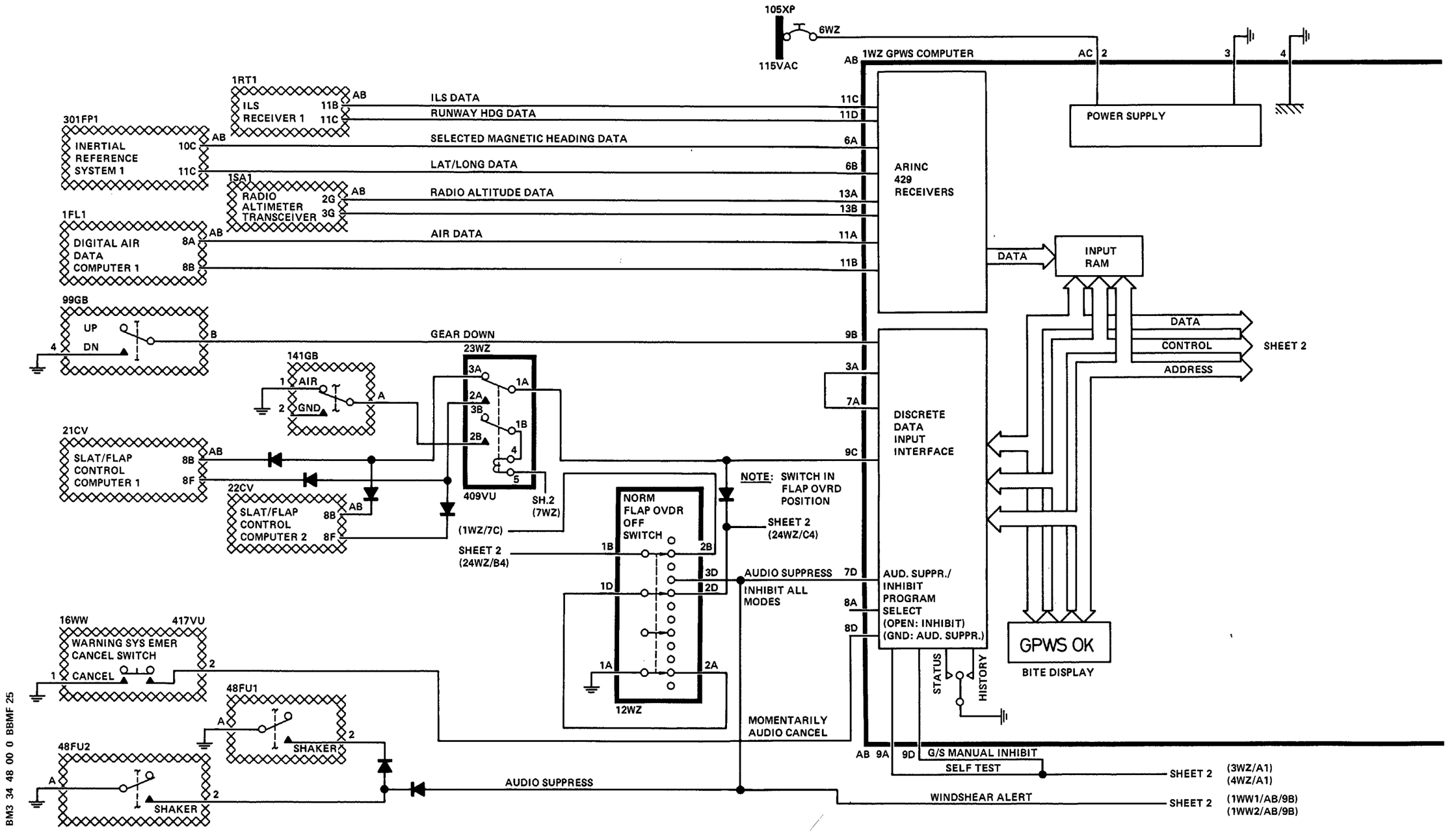
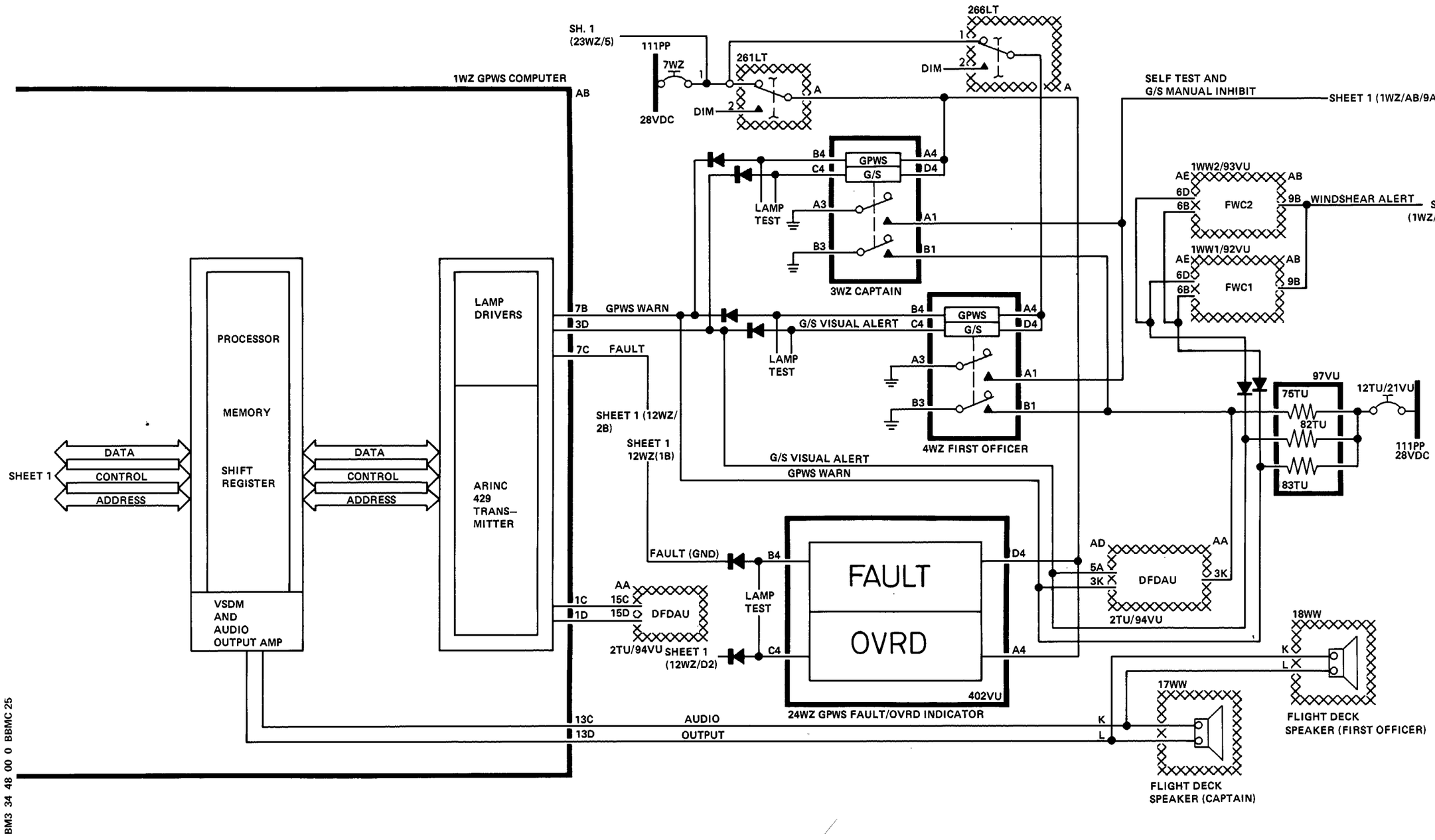


Input Signal Conditioning (Discrete)
Figure 007



GPWS Schematic Diagram (Sheet 1 of 2)
Figure 008



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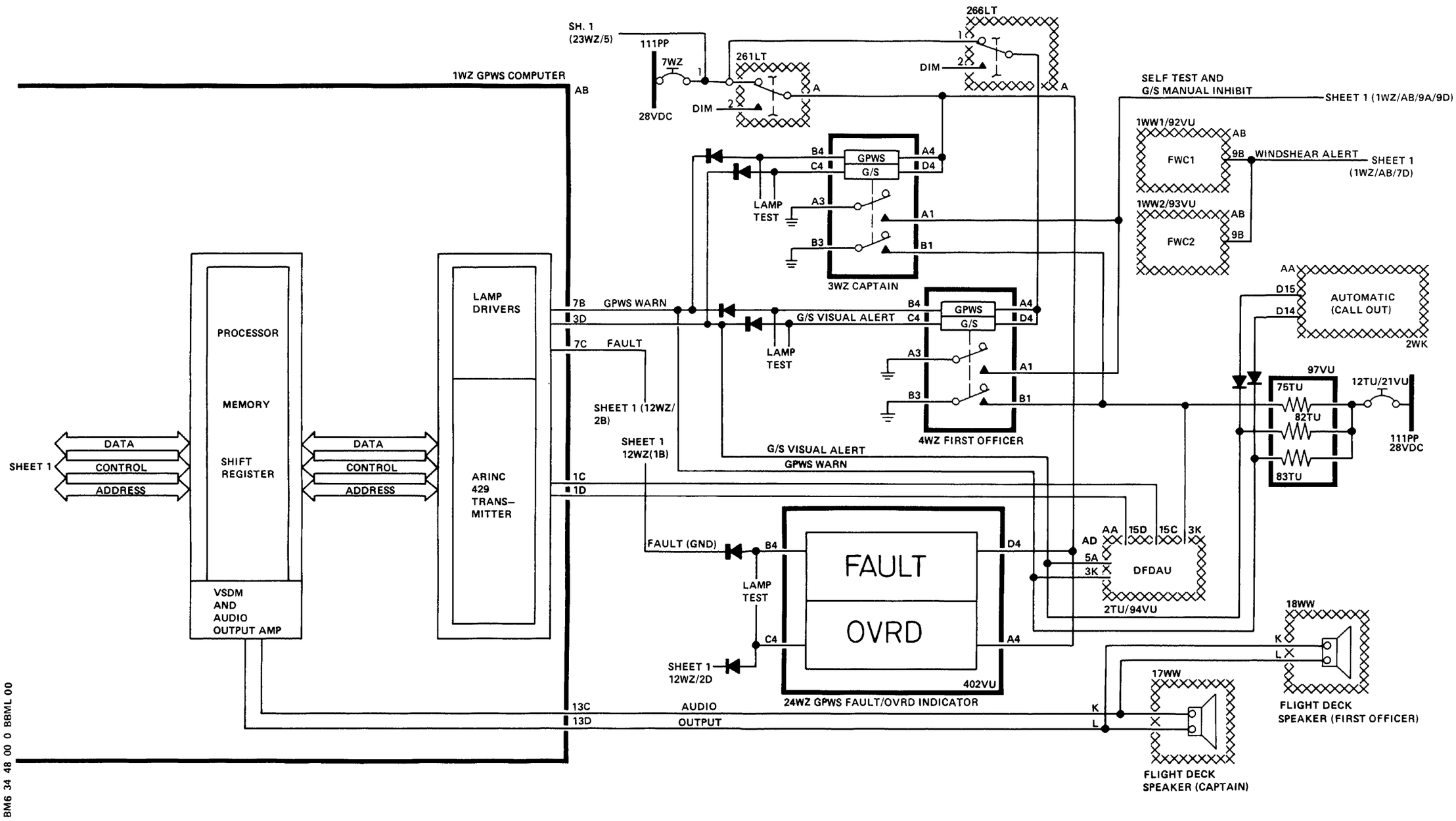
GPWS Schematic Diagram (Sheet 2 of 2)
Figure 008



GPWS Schematic Diagram (Sheet 2 of 2)
Figure 008

R EFFECTIVITY: 004-100,

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- Stall warning relays
- WARNING SYS EMER CANCEL
- GPWS - G/S indicator lights (self test and G/S warn inhibit).

(3)The serial digital data and discrete data inputs are interfaced and used in different combinations to monitor aircraft vertical performance. The following functions are monitored:
- Mode 1 : excessive rate of descent
- Mode 2 : excessive closure rate
- Mode 3 : loss of height after take-off
- Mode 4 : terrain clearance
- Mode 5 : descent below glideslope
- Mode 6 : descent below decision height

NOTE : Mode 6 is not used in this installation. Decision height annunciation is provided by the flight warning computer.

(4)Each mode computes and compares aircraft behaviour with a corresponding warning envelope. If the warning envelope is 'penetrated', voice warning circuits generate an appropriate aural message which is broadcast over the flight compartment speakers. The aural messages are as follows.

Mode		Warning	Trigger
1	-	"SINK RATE"	Sinkrate
	-	"WHOOP WHOOP PULL-UP"	pull-up
2	-	"TERRAIN" (See Note)	Terrain
	-	"WHOOP WHOOP PULL-UP"	pull-up
3	-	"SINK RATE"	Dont sink
	-	"SINK RATE"	Dont sink-gear
3	-	"TERRAIN"	Too low
4A	-	"TERRAIN"	Too low-gear
4B	-	"TERRAIN"	Too low-flap
		"TERRAIN"	Too low-terrain
5	-	"GLIDESLOPE"	Glideslope

NOTE : In mode 2 operation, after approximately 1.4 seconds of the "TERRAIN" aural warning. "WHOOP WHOOP PULL-UP" is continuously broadcast until the envelope boundary is departed. Then the warning will revert to "TERRAIN" until the aircraft has climbed through 300 ft. of barometric altitude.

The GPWC also provides visual warning signals to the captain's and flight officer's GPWS - G/S pushbutton switch lights.

(5)Warnings may be cancelled by:
- (a)Pressing the WARNING SYS EMER CANCEL switch (Aural only).
- (b)In mode 5 only. Pressing the captain's or first officer's GPWS - G/S pushbutton switch light (Glideslope only).
- (c)Setting the NORM/FLAP OVRD/OFF switch to OFF (System inhibit).
- (d)GPWC is automatically inhibited if a stall warning is in progress (Stick shaker activated).

(6)Faults which prevent normal operations of the GPWC are stored in the

BITE memory and may be read on the BITE display by operating the STATUS/HISTORY switch located on the front of the GPWC below the BITE display. When a fault is stored the GPWS FAULT indicator comes on.

(7)Electrical power for the system is derived from the following busbars:
- 28VDC bus 111PP via circuit breaker 7WZ for GPWS - G/S indicator lights, FAULT indicator and OVRD indicator.
- 115VAC bus 105XPA via circuit breaker 6WZ (for GPWC).

**ON A/C 005-100,

A. Overall System Operation

(1)The GPWC receives serial digital data inputs from the following:
- Radio altimeter transceiver 1 (Radio altitude)
- Digital air data computer 1 (barometric altitude, barometric altitude rate, computed airspeed).
- ILS receiver 1 (glideslope deviation, selected runway heading)
- Inertial reference system 1 (magnetic heading).

(2)Discrete data inputs are received from the following:
- Gear relays
- SFCC 1 and 2 (flaps at 20 or 40 degrees)
- Stall warning relays
- WARNING SYS EMER CANCEL
- GPWS - G/S indicator lights (self test and G/S warn inhibit).

(3)The serial digital data and discrete data inputs are interfaced and used in different combinations to monitor aircraft vertical performance. The following functions are monitored:
- Mode 1 : excessive rate of descent
- Mode 2 : terrain closure rate
- Mode 3 : excessive loss of altitude after take-off
- Mode 4 : unsafe terrain clearance
- Mode 5 : descent below glideslope
- Mode 6 : altitude call-outs
- Mode 7 : windshear detection and annunciation

(4)Each mode computes and compares aircraft behavior with a corresponding warning envelope. If the warning envelope is 'penetrated', voice warning circuits generate an appropriate aural message which is broadcast over the flight compartment speakers. The aural messages are selectable in detail by 'program pin strapping' for the altitude call-outs and the other aural warnings.
The basic aural warning are as follows:

Mode		Warning	Trigger
1	-	"SINK RATE SINK RATE"	Sink rate
	-	"(WHOOP WHOOP) PULL-UP"	pull-up
2	-	"TERRAIN" (or equivalent)	Terrain
	-	"WHOOP WHOOP PULL-UP"	pull-up preface or pull-up
3	-	"DON'T SINK DON'T SINK"	Don't sink

		(or equivalent)	
4A	-	"TOO LOW GEAR" (or equivalent)	Too low gear/terrain
4B	-	"TOO LOW FLAPS" (or equivalent)	Too low flaps/terrain
4C	-	"TOO LOW TERRAIN" (or equivalent)	Too low terrain
5	-	"GLIDESLOPE"	Glideslope
6	-	various altitude call-outs	Altitude menu
	-	"MINIMUMS" (or equivalent)	Minimums/Minimums
	-	"DECISION HEIGHT"	Decision height
	-	"APPROACHING MINIMUM"	Approaching minimums
	-	"APPROACHING DECISION HEIGHT"	Approaching decision height
	-	"BANK ANGLE BANK ANGLE"	Bank angle
	-	"FIVE HUNDRED" (or disabled)	Smart call-out
7	-	(SIREN) "WINDSHEAR	Windshear warning
	-	WINDSHEAR WINDSHEAR"	Windshear alert
	-	(quiet)	

NOTE : In mode 2 operation, after approximately 1.4 s of the "TERRAIN" aural warning, "WHOOP WHOOP PULL-UP" is continuously broadcast until the envelope boundary is departed. Then the warning will revert to "TERRAIN" until the aircraft has climbed through 300 ft. of barometric altitude.

The GPWC also provides visual warning signals to the captain's and flight officer's GPWS - G/S pushbutton switch lights.

(5)Warnings may be cancelled by:
- (a)Pressing the WARNING SYS EMER CANCEL switch (aural only).
- (b)Pressing the captain's or first officer's GPWS - G/S pushbutton switch light (Glideslope (mode 5) only).
- (c)Setting the NORM/FLAP OVRD/OFF switch to OFF (system inhibit).
- (d)GPWC is automatically inhibited if a stall warning is in progress (stick shaker activated).

(6)Faults which prevent normal operations of the GPWC are stored in the BITE memory and may be read on the BITE display by operating the STATUS/HISTORY switch located on the front of the GPWC below the BITE display. When a fault is stored the GPWS FAULT indicator comes on.

(7)Electrical power for the system is supplied by from the following busbars:
- 28VDC bus 111PP via circuit breaker 7WZ for GPWS - G/S indicator lights, FAULT indicator and OVRD indicator.
- 115VAC bus 105XPA via circuit breaker 6WZ (for GPWC).

R **ON A/C 001-100,

(8)The GPWC inhibits all GPWS modes for at least 5 s if a WINDSHEAR

alert is present. The WINDSHEAR alert is generated by the two Flight Warning Computers (FWC). In case of such an alert, the signal is feed for 5 s to the INHIBIT ALL MODES input of the GPWC.
The GPWC inhibits then all GPWS modes to avoid misunderstandings caused by generated voice messages.

B. Detailed Operation (GPWC) (Ref. Fig. 006, 007)

(1) Input signal conditioning

(a) The radio altitude data word is identified by its label (164 octal) and contains radio altitude with a resolution of 0.125 ft. and radio altimeter operating status (data validity). The parallel format output from the ARINC 429 receiver is filtered to produce 'rad. alt 1' for mode 2 closure rate calculations. A further filter produces 'rad. alt 2' for use in all modes of operation.
Data validity is combined with the result of an internal data reasonableness test to produce a 'rad. alt' valid discrete for internal monitoring.

(b) Three air data words are accepted by the GPWC:
- Barometric altitude rate (label 212 octal), containing barometric rate of descent with a resolution of 16 ft/min, and data validity
- Barometric altitude (label 203 octal), containing uncorrected barometric altitude with a resolution of 1 ft., and data validity
- Computed airspeed (label 206 octal), containing computed airspeed with a resolution of 0.0625 kts and data validity.

The air data words are processed in a similar manner to the radio altitude input to produce 'baro rate 1' (mode 3), 'baro rate 2' (mode 1 and 2) 'baro alt' (mode 2 and 3), 'airspeed' (mode 2 and 4) and associated 'valid' discretes. If 'baro rate valid' is set to logic 0 or if 'rad alt' is less than 30 ft., 'baro rate 1' and '2' are automatically set to 0 ft./min. If 'airspeed valid' is set to logic 0 or if flaps are set to 20 or 40 degs., 'airspeed' is automatically set to 0 kts.

(c) Two ILS data words are accepted by the GPWC:
- Glideslope deviation (label 174 octal)
- Selected runway heading (label 017 octal) (ref. para. (d)).

Glideslope deviation is filtered to remove the effects of beam instability and to produce 'G/S dev 1' and 'G/S dev 2' for mode 5 use. 'G/S valid' is derived from the status bits contained in the glideslope deviation data word.
Because ILS and VOR have separate controls there is no ILS valid signal to enable mode 5. To produce the required signal the computer assumes the ILS valid is good. It then checks the G/S valid, if good, an ILS select valid is generated.

(d) Selected runway heading (label 017 octal) and its associated validity is used in conjunction with magnetic heading data (014 octal) to provide a 'backcourse' inhibit input for mode 5 use. If aircraft magnetic heading and runway heading differ by more than 90 deg, and both signals are valid, the 'backcourse inhibit' discrete is set.

(e) Discrete inputs to the GPWC provide mode selection, bias and inhibit functions.
The switching interlocks provided by stall warning relays 48FU1, 48FU2, the WARNING SYS EMER CANCEL switch and the GPWS NORM/FLAP

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OVRD/OFF switch control, inhibit/suppress logic in the GPWC.
An 'inhibit all modes' discrete is generated if:
- the NORM/FLAP OVRD/OFF switch is set OFF, or
- the NORM/FLAP OVRD/OFF switch is set to NORM or FLAP OVRD, stall warning relays 48FU1 and 48FU2 are energized.

An 'audio suppress' discrete is generated if:
- the NORM/FLAP OVRD/OFF switch is set to NORM or FLAP OVRD and the WARNING SYS EMER CANCEL switch is actuated (CANCEL selected).

The 'inhibit all modes' discrete forms part of the master valid logic. If 'inhibit all modes' is set to logic 0, power supplies are within a pre-defined limit and 'radio alt valid' is set to logic 1, a 'master valid' discrete is set.
The 'master valid' and 'audio suppress' discretes are used as enable/inhibit commands for mode computations and warning output circuits.
G/S manual inhibit (from GPWS - G/S indicator lights) and self test are buffered and distributed to mode computations and BITE. The audio program is also buffered and is fed to the warning output circuits.
The gear down signal from relay 99GB and the flaps 20 or 40 deg. signal from SFCC1 and 2 are used to produce 'gear 1-3' and 'flaps 1' and '2' discretes as indicated. The discretes are used in mode computations to enable monitor and also to modify warning envelopes.
The 'master valid' discrete combines with height discriminants, and gear and flap discretes to produce a 'take-off mode' or an 'approach' mode signal for modes 3, 4 and 5.

(2)GPWC Mode Computations

R **ON A/C 001-004,

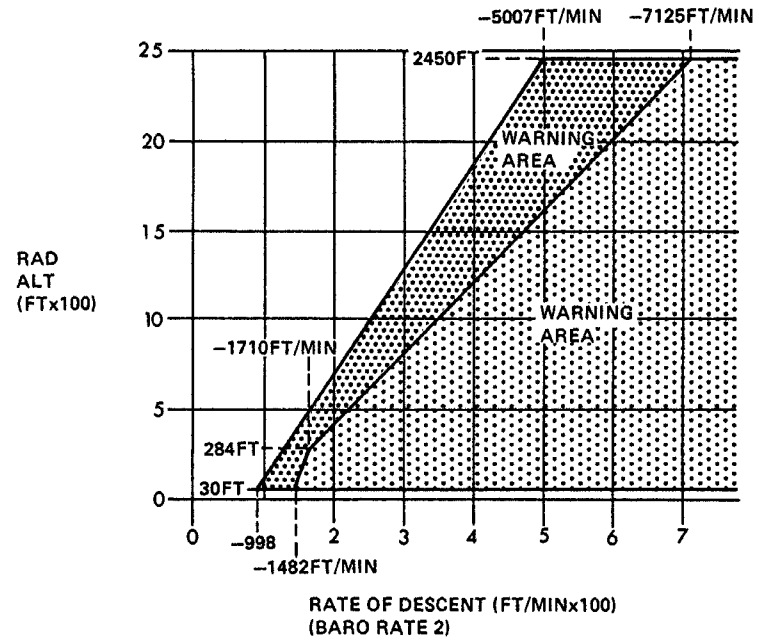
(Ref. Fig. 009)

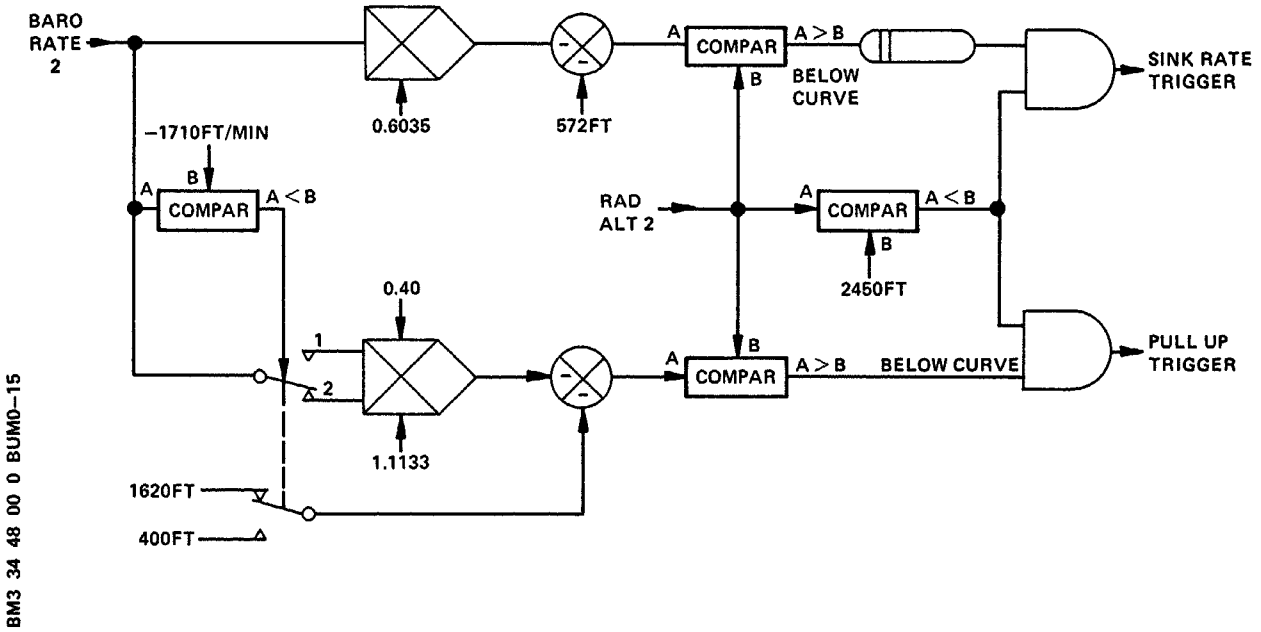
**ON A/C 005-100,

(Ref. Fig. 010)

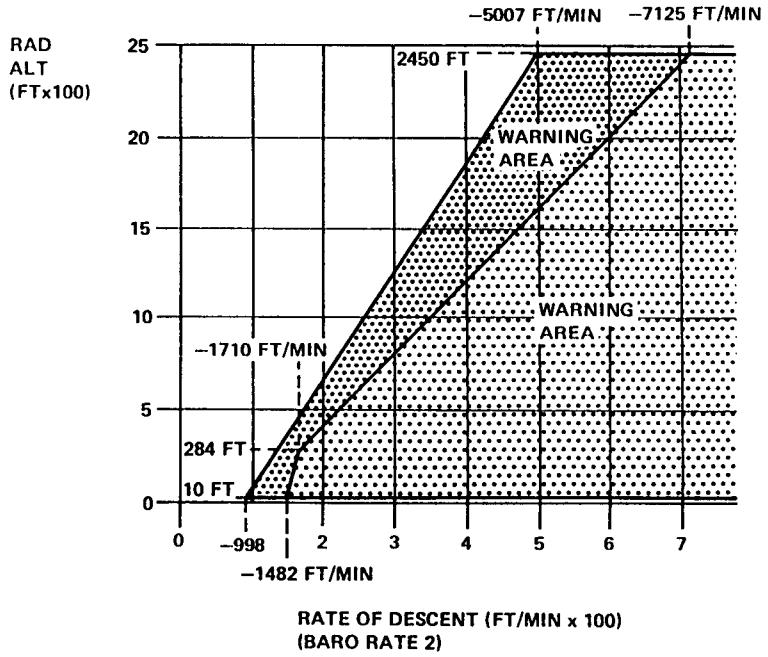
R **ON A/C 001-004,

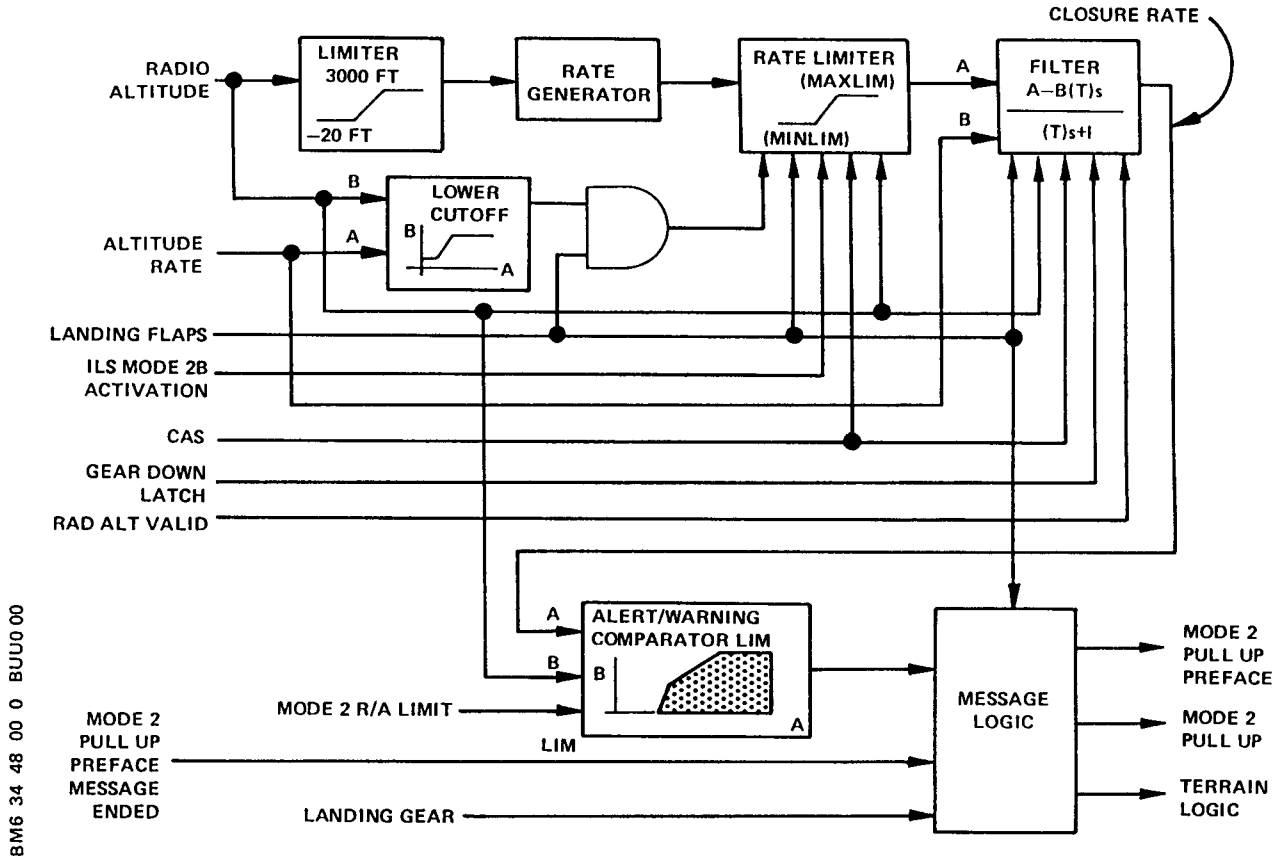
(a)Mode 1 - excessive rate of descent
Mode 1 computations are based on 'baro rate 2' and 'rad. alt. 2' data, and provide warning triggers if the envelope shown is penetrated.
Initial penetration results in a 'sink rate' trigger and further penetration substitutes a 'pull-up' trigger for the warning output circuits. A 0.8 sec delay is incorporated in the 'sink rate' trigger circuit to minimize warnings if the boundary is momentarily penetrated.
The sink rate boundary is defined by the equation:
Warn Height = -572 ft. -(0.6035 x 'baro rate 2).
The lower region of the pull-up boundary is defined by the equation:
Warn Height = -1620 ft. -(1.113 x 'baro rate 2').
The upper region of the pull-up boundary is defined by the equation:
Warn Height = -400 ft. -(0.4 x 'baro rate 2').





Mode 1 Warning Envelope and Computation
Figure 009





Mode 1 - Warning Envelope and Computation
Figure 010

(b)Mode 2 Terrain closure rate

**ON A/C 005-100,

(a)Mode 1 - excessive rate of descent
Mode 1 computations are based on 'baro rate 2' and 'rad. alt. 2' data, and provide warning triggers if the envelope shown is penetrated. Initial penetration results in a 'SINK RATE' trigger and further penetration substitutes a 'PULL-UP' trigger for the warning output circuits. A 0.8 s delay is incorporated in the 'SINK RATE' trigger circuit to minimize warnings if the boundary is momentarily penetrated.

The sink rate boundary is defined by the equation:

Minimum Terrain Clearance (ft) = -572 ft. -(0.6035 x 'baro rate 2').

The lower region of the pull-up boundary is defined by the equation:
Minimum Terrain Clearance (ft) = -1620 ft. -(1.113 x 'baro rate 2').

The upper region of the pull-up boundary is defined by the equation:

Minimum Terrain Clearance (ft) = -400 ft. -(0.4 x 'baro rate 2').

(b)Mode 2 Terrain closure rate

R **ON A/C 001-004,

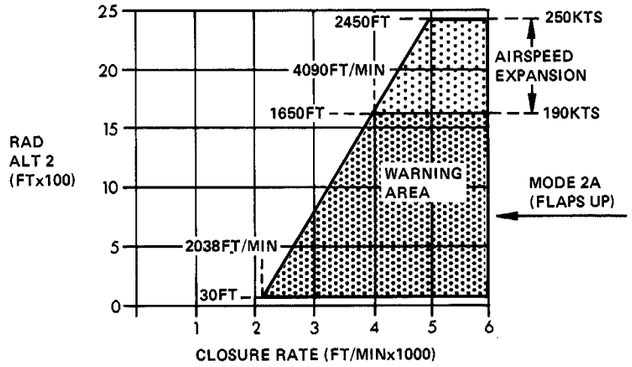
(Ref. Fig. 011)

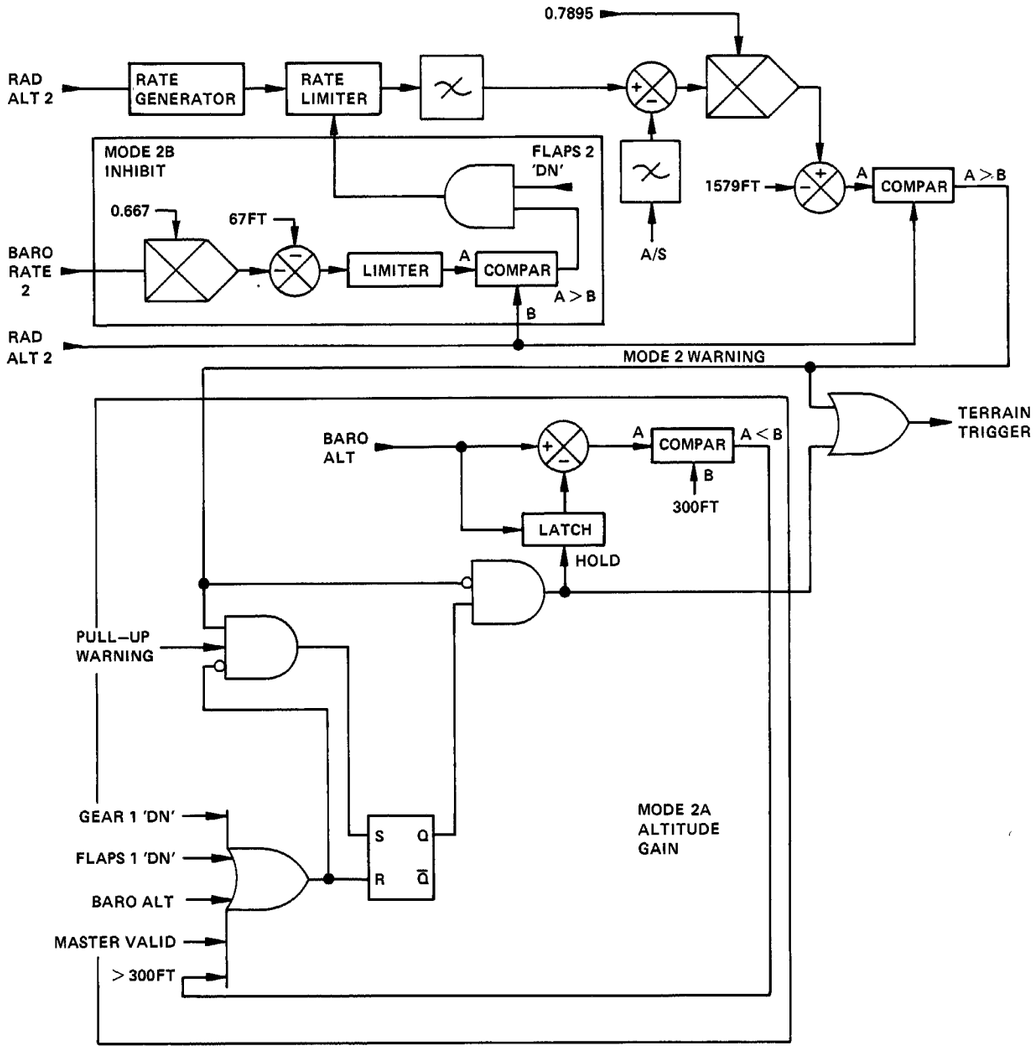
**ON A/C 005-100,

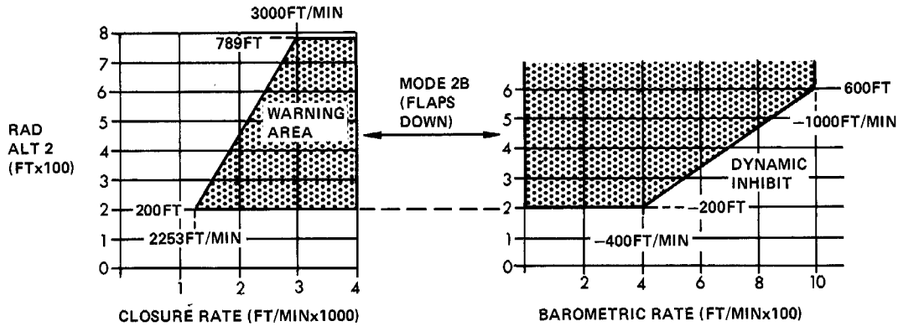
(Ref. Fig. 012)

R **ON A/C 001-004,

Mode 2 has two envelopes, mode 2A and mode 2B both based on radio altimeter input and the rate of decrease of 'rad alt 1'. Mode 2A is applied when the flaps are up and Mode 2B is applied when the flaps are down. Mode 2A boundary is defined by the equation:
Warn Height = -1579 ft + (0.7895 x closure rate (ft per min)).
The upper limit of the boundary is horizontal at 1650 ft. As the airspeed is increased from 190 kts to 250 kts the upper boundary is linearly increased to 2450 ft.
Upon penetrating the boundary, either on the slope or from the top, the warning lights come on and the voice message is "Terrain". If the boundary penetration lasts beyond two "Terrain" messages, approximately 1.4 seconds, then the warning switches to "Whoop Whoop - Pull Up" repeated continuously until the boundary is departed. If the landing gear is up at this time, the altitude gain feature is automatically activated. First the barometric altitude at this instant is sampled and stored. The warning lights remain on and the voice message is

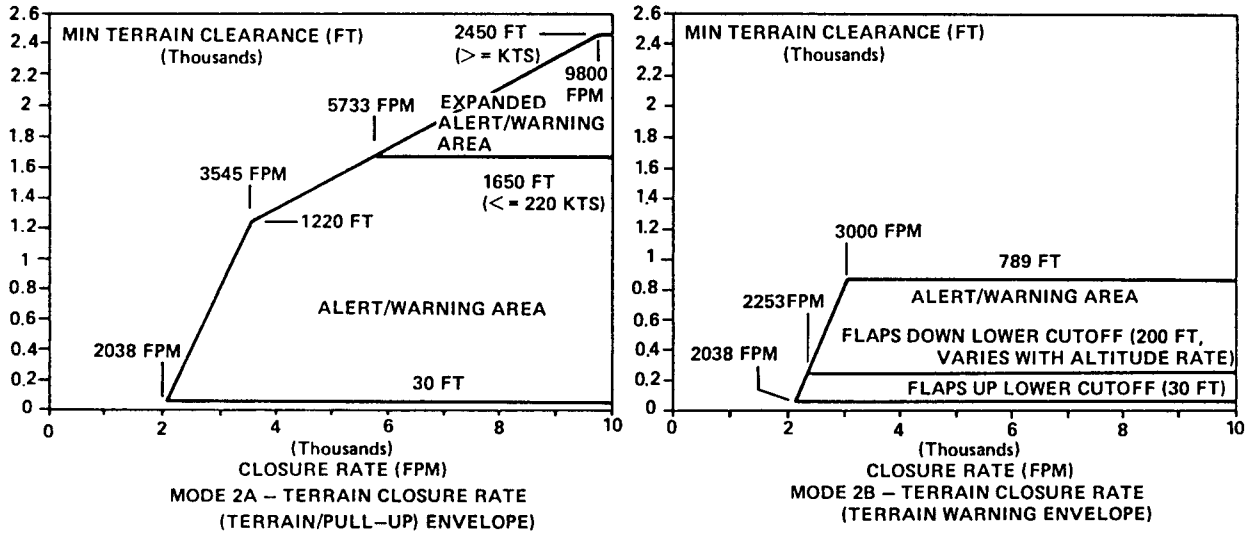


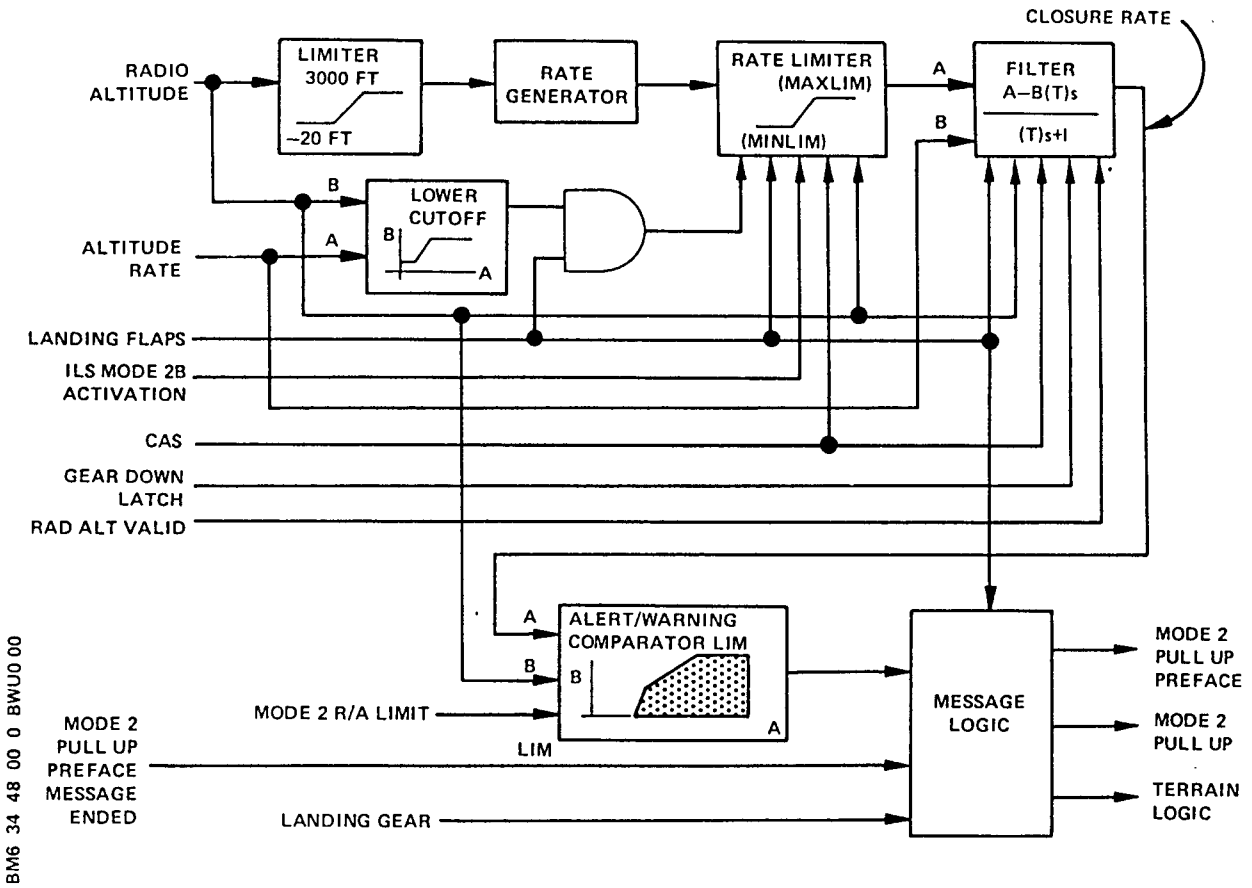




BM3 34 48 00 0 BWM0–15

Mode 2 Warning Envelope and Computation
Figure 011





Mode 2 - Warning Envelope and Computation
Figure 012

"Terrain." After three hundred feet of barometric altitude has been gained from the stored value all warning lights and voice stop. If another boundary penetration occurs during this altitude gain time and it lasts long enough to restart the "Pull-Up" warning, 1.4 seconds, then the whole process begins again with a new reference altitude for the 300 feet after boundary separation. In this manner the aircraft is directed up and over the terrain to a safer altitude.

Lowering the flaps to the landing position automatically switches the program to Mode 2B. This boundary is the same as the Mode 2A boundary except the upper limit has been lowered to 789 feet at a maximum closure rate of 3000 FPM.
A mode 2B lower cutoff function has been introduced to prevent nuisance warning during high approach speeds and/or high approach angles. The cut-off is a function of radio altitude and 'Baro rate'.
The envelope increases linearly from 200 to 600 ft radio altitude as the vertical speed increases from -400 to -1000 ft/min.
Any warning generated by the normal mode 2B function will be inhibited should the aircraft also penetrate the cut-off.

(c)Mode 3

1 Descent after take-off

**ON A/C 005-100,

Mode 2 has two envelopes, mode 2A and mode 2B, both based on radio altimeter input and the rate of decrease of 'rad alt 1'. Mode 2A is applied when the flaps are up and Mode 2B is applied when the flaps are down. Mode 2A boundary is defined by the equation:

Minimum Terrain Clearance (ft.) = -1579 ft. + (0.7895 x closure rate (ft. per min)).

The upper limit of the boundary is horizontal at 1650 ft. As the airspeed is increased from 220 kts to 310 kts the upper boundary is linearly increased to 2450 ft.
Upon penetrating the boundary, either on the slope or from the top, the warning lights come on and the voice message is "TERRAIN" or equivalent. If the boundary penetration lasts beyond two "TERRAIN" or equivalent messages, approximately -1.0 s, then the warning switches to "(WHOOP WHOOP) PULL-UP" or equivalent repeated continuously until the boundary is departed. If the landing gear is up at this time, the altitude gain feature is automatically activated. First the barometric altitude at this instant is sampled and stored. The warning lights remain on and the voice message is "TERRAIN" or equivalent. After three hundred feet of barometric altitude has been gained from the stored value all warning lights and voice stop. If another boundary penetration occurs during this altitude gain time and it lasts long enough, -1.4 s, to restart the "PULL-UP" or equivalent warning, then the whole process begins again with a new reference altitude for the 300 ft. after boundary separation. In this manner the aircraft is directed up and over the terrain to a

safer altitude.

Lowering the flaps to the landing position automatically switches the program to mode 2B. This boundary is the same as the mode 2A boundary except the upper limit has been lowered to 789 ft. at a maximum closure rate of 3000 FPM.
A mode 2B lower cutoff function has been introduced to prevent nuisance warning during high approach speeds and/or high approach angles. The cut-off is a function of radio altitude and 'Baro rate'. The envelope increases linearly from 200 to 800 ft. minimum terrain clearance.
Any warning generated by the normal mode 2B function will be inhibited should the aircraft also penetrate the cut-off.

(c)Mode 3

1 Excessive altitude loss after take-off

R **ON A/C 001-004,

(Ref. Fig. 013)

**ON A/C 005-100,

(Ref. Fig. 014)

R **ON A/C 001-004,

Mode 3 computations are based on 'baro alt.' and 'rad. alt. 2' data, and provide a warning trigger if the warning envelope shown is penetrated. Mode 3 is operative when the internally generated 'take-off' mode discrete is present and 'rad. alt. 2' is between 30 ft. and 667 ft.
Penetration of the warning envelope results in a 'don't sink' or a 'don't sink-gear'trigger depending on the state of the 'gear 1' discrete producing a "TERRAIN" warning. Aircraft descent is detected by the polarity of 'baro rate 1'. When descent is detected, 'baro. alt' is stored and subsequent values of 'baro. alt.' and 'rad. alt. 2' are used to determine a warning condition. The stored value of 'baro. alt.' is retained until exceeded by its current value. The warning trigger is removed when 'baro rate 1' polarity indicates climb.
A return to a descent condition will trigger a subsequent warning based on last stored 'baro. alt'.
The mode 3 boundary is defined by the equation:
Warn alt loss = 5.4 ft. +(0.092 x 'rad. alt 2' + 'rad, alt 2' x time x 1.34 x 10_0^3

2 Minimum terrain clearance

**ON A/C 005-100,

Mode 3 provides a warning for excessive altitude loss after take-off. It is based primarily on radio altitude, inertial or barometric altitude, and inertial vertical speed or barometric rate. A

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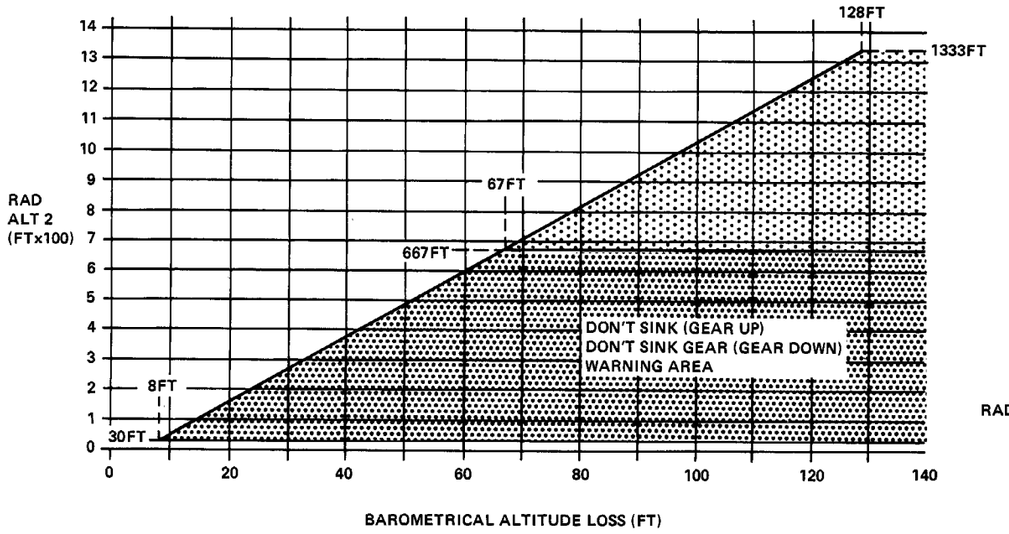
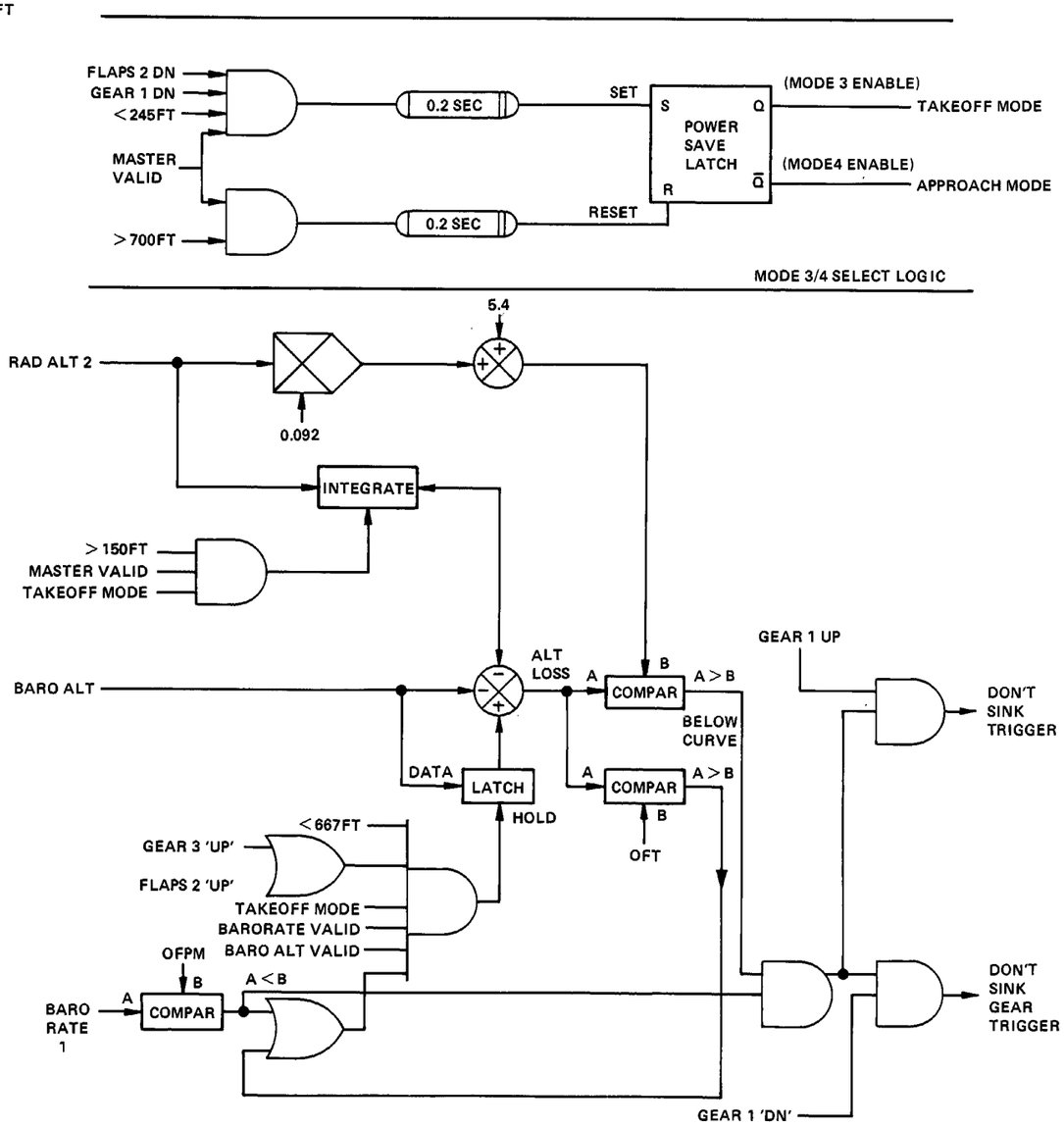
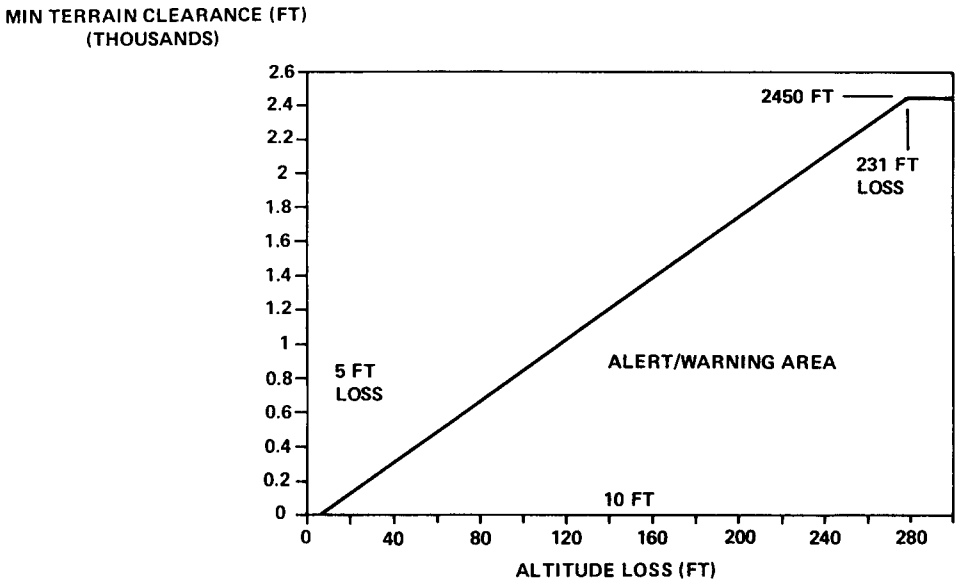


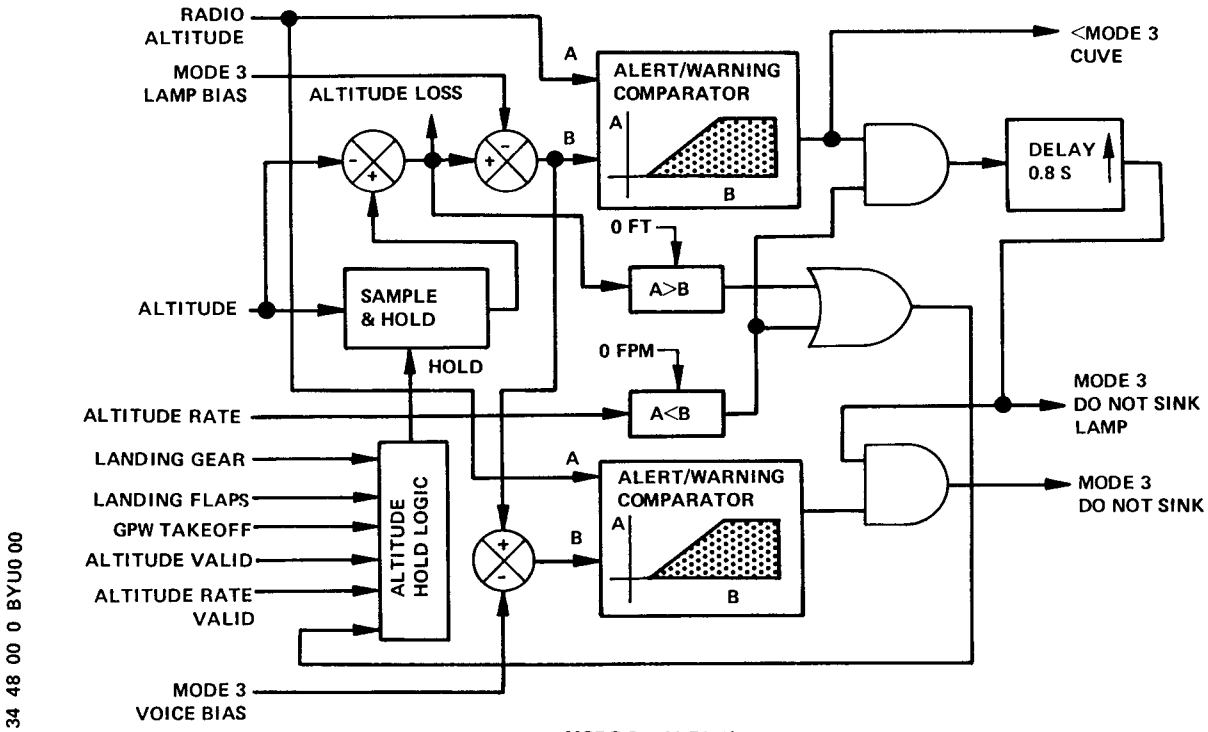


BM3 34 48 00 0 BYM0 28

Mode 3 - Descent after take-off
Figure 013



MODE 3 – ALTITUDE LOSS AFTER TAKEOFF (DO NOT SINK WARNING ENVELOPE)



MODE 3– ALERT/WARNING LOGIC

BM6 34 48 00 0 BYU0 00

Mode 3 - Excessive Altitude Loss after Take-off
Figure 014

penetration of this envelope results in the warning 'DON'T SINK' or equivalent trigger. This warning is triggered only during and after take-off, when the aircraft should descend again and has lost a predetermined amount of altitude.

The mode 3 slope is defined by the equation:

Altitude loss (ft.) = 5.4 ft. + 0.092 x radio altitude (ft.).

When enhanced mode 3 is selected, the algorithm uses altitude above field elevation instead of radio altitude.

Once a descend begins during the take-off sequence, the GPWC will store the existing altitude. This value, indicating where the descent began, is retained until the aircraft ascends above the stored value again. The logic within the GPWC prevents the possibility of stair stepping down without the mode 3 warning to be retriggered.

2 Minimum terrain clearance

R **ON A/C 001-100,

(Ref. Fig. 015)

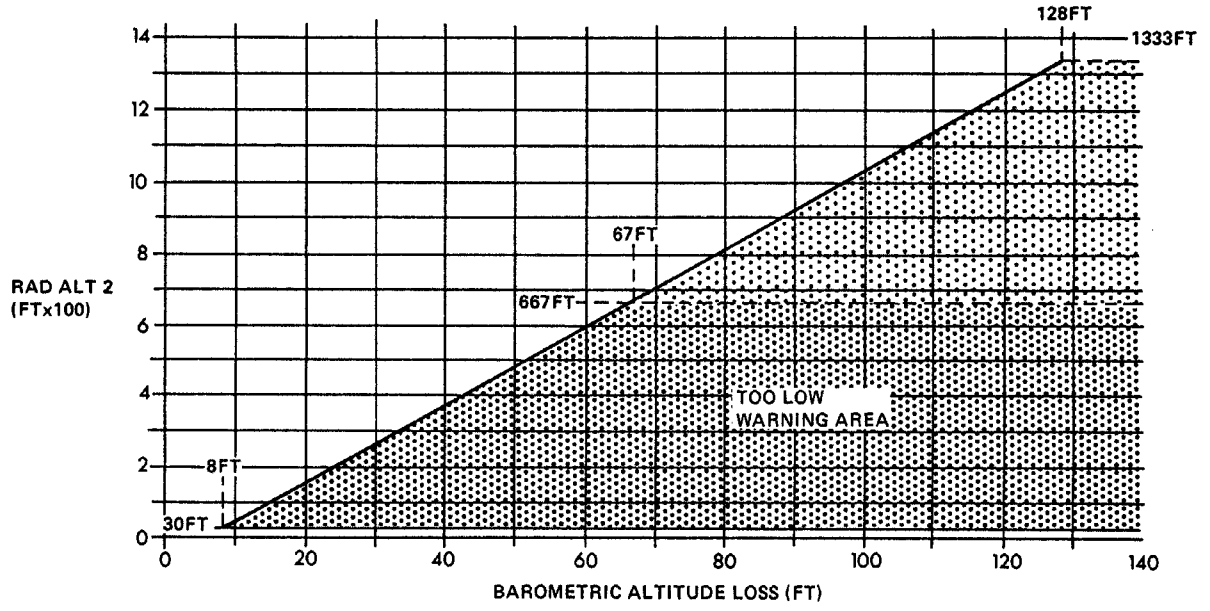
R **ON A/C 001-004,

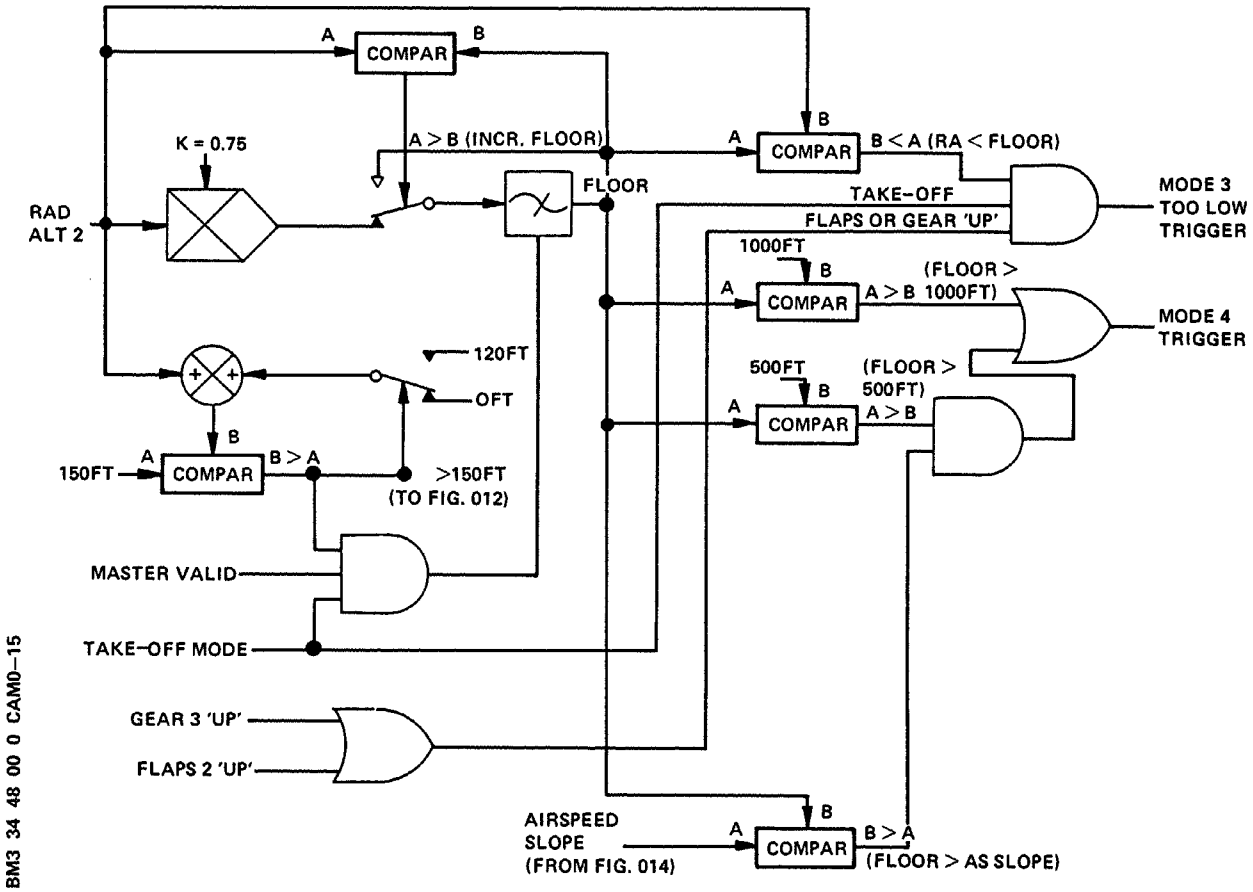
A minimum terrain clearance envelope is provided to prevent a collision, during take-off climb, into terrain that produces insufficient closure rate for a Mode 2 (terrain closure rate) warning. The warning is based on a minimum radio altitude clearance after take-off and airspeed until the Mode 4 (terrain clearance) faction comes into operation.

Penetration of the warning envelope results in a 'too low' trigger to produce a TOO LOW aural warning which is operative over a radio altitude range of 150 feet thru 1333 feet. The warning is based on a minimum terrain clearance, or floor, which increases with radio altitude during take-off. A value equal to 75% of the current radio altitude is accumulated in a long term filter that is only permitted to increase in value. Should the radio altitude later decrease, the filter will store its maximum attained value and any further decrease in radio altitude, with gear or flaps 'up' discrete inputs, will propagate the warning.

The filter output is also compared with airspeed to generate a > Mode 4 term for switching from Mode 3 to Mode 4. Should the filter output be less than the airspeed curve, mode switching will occur at a filter value of 500 feet (i.e. approximately 75% of 667 feet), otherwise at a filter value of 1000 feet (approximately 75% of 1333 feet).

(d)Mode 4 - Terrain clearance





Mode 3 - Terrain Clearance
Figure 015

**ON A/C 005-100,

In standard mode 3 operation, the "DON'T SINK" or equivalent message is repeated until the situation is rectified. This constant voice message can cause a distraction in the cockpit for cases where aircraft performance is degraded and the pilot is struggling to maintain a positive climb angle. In alternate mode 3 operation, two voice messages are given. Then the voice warning conditions are updated to +20 % of the initial radio altitude. If the aircraft does not loose this additional altitude, no further voice warnings are given. If, on the other hand, this altitude is also lost, then two additional messages are given and another 20 % of radio altitude is added into the warning mode calculation. This procress of ratcheting the voice warning continues until the original altitude is recovered. The warning lamp is not affected. A delay euivalent to 0.8 s is added to the warning output to prevent nuisance warnings caused by air turbulence during gear retraction.

(d)Mode 4 - Terrain clearance

R **ON A/C 001-004,

(Ref. Fig. 016)

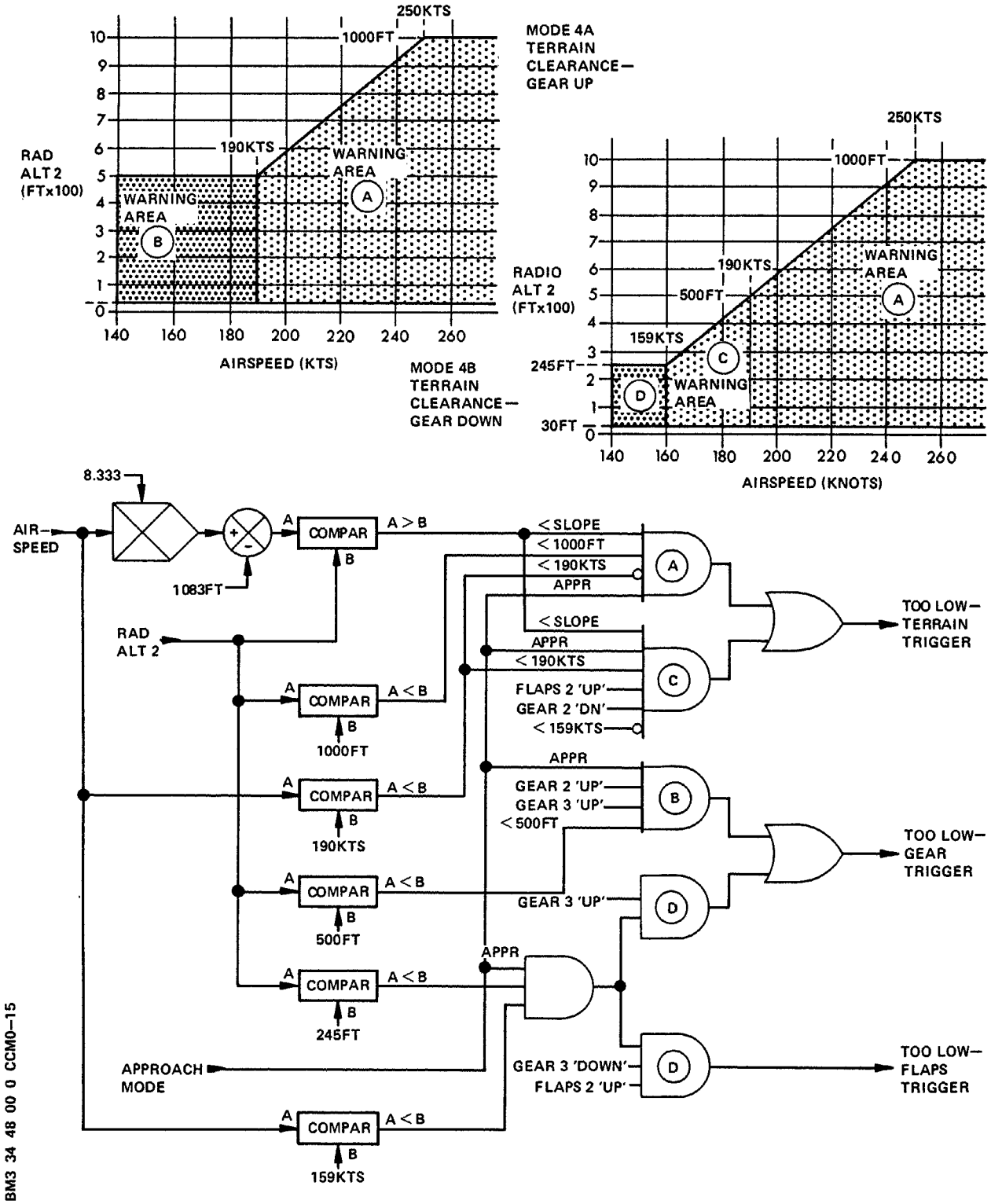
**ON A/C 005-100,

(Ref. Fig. 017)
(Ref. Fig. 018)

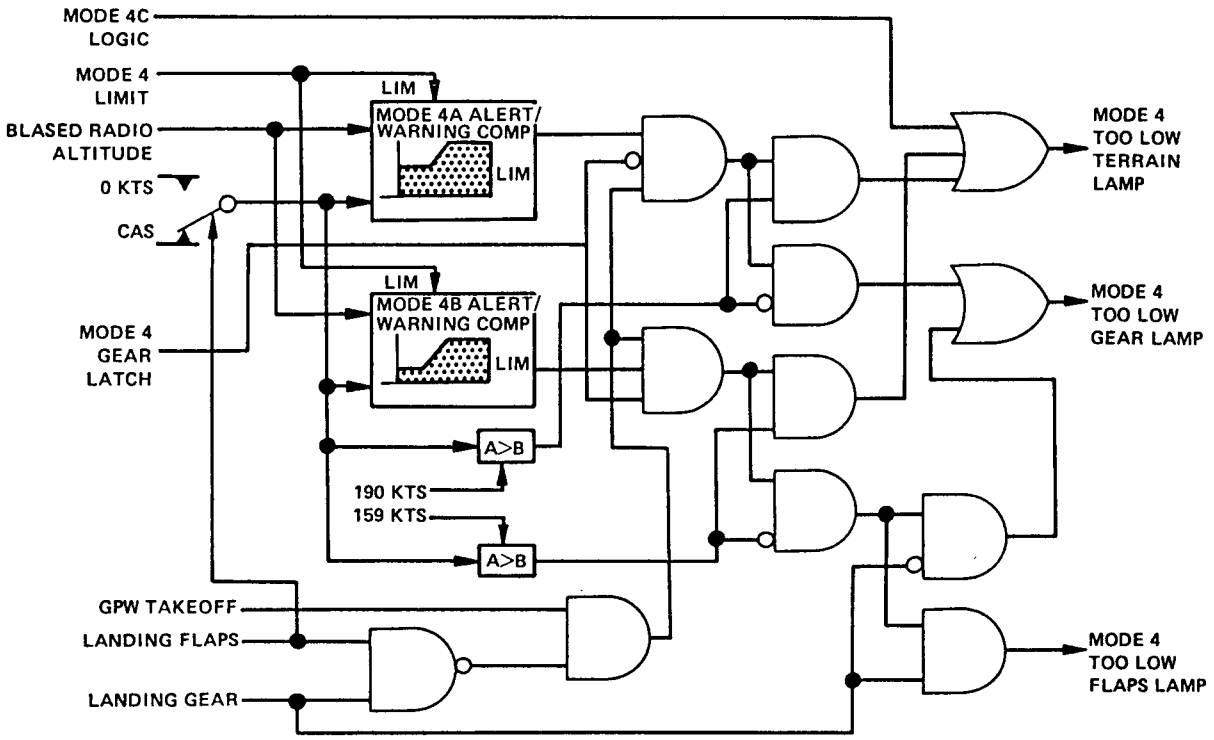
R **ON A/C 001-004,

Mode 4 computations are based on 'rad. alt. 2' and 'airspeed'. Separate warning envelopes are provided for gear-up (mode 4A) and gear-down (mode 4B) configuration.
The standard mode 4A upper boundary is at 500 ft. radio altitude. If the aircraft penetrates this portion of the envelope, a 'too low-gear' trigger is generated. At 190 kts 'airspeed', the envelope extends linearly with 'airspeed' to 1000 ft. at 250 kts and above. If this portion of the envelope is penetrated, a 'too low-terrain' trigger is produced resulting in a "TERRAIN" warning.
Mode 4B is enabled when 'gear 3' discrete indicates 'down'. The upper boundary is lowered to 245 ft. and linear expansion with airspeed occurs at 159 kts. Penetration of the envelope below 159 kts results in a 'too low-flaps' trigger. Penetration of the envelope above 159 kts results in a 'too low-terrain' trigger producing a "TERRAIN" warning.
The mode 4A and 4B boundaries are defined by the equation:
Warn Height = -1083 ft. +(8.333 x 'airspeed').

(e)Mode 5 - descent below glideslope



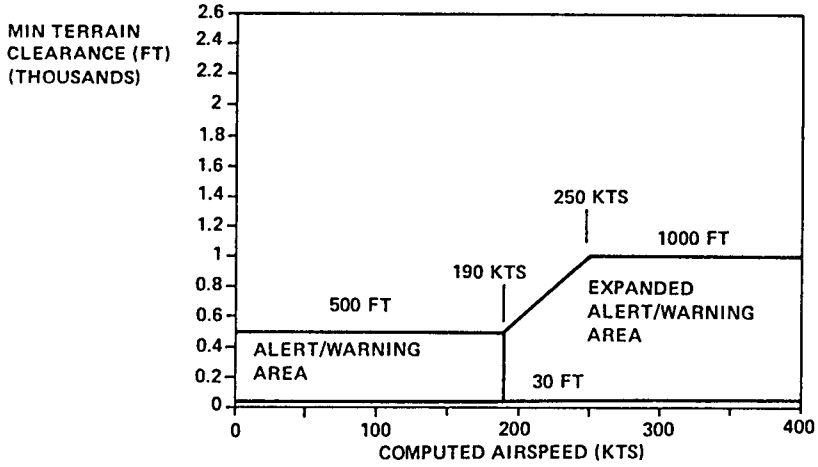
Mode 4 Warning Envelope and Computation
Figure 016



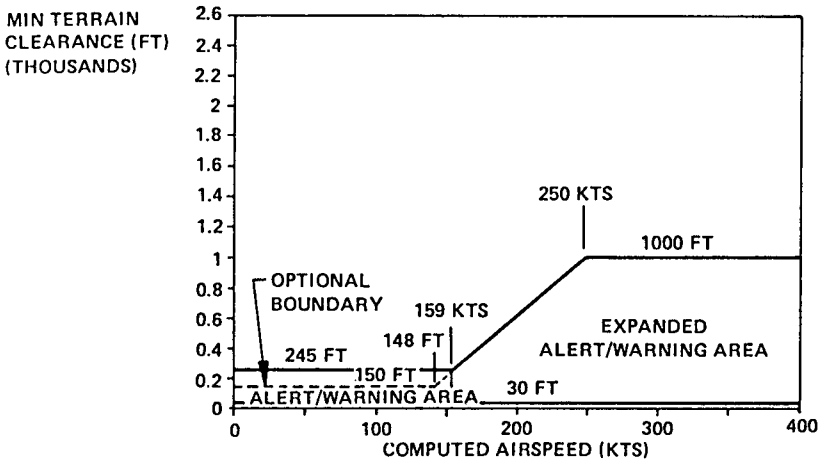
MODE 4— VOICE AND LAMP FUNCTIONAL BLACK DIAGRAM

BM6 34 48 00 0 CCF0 00

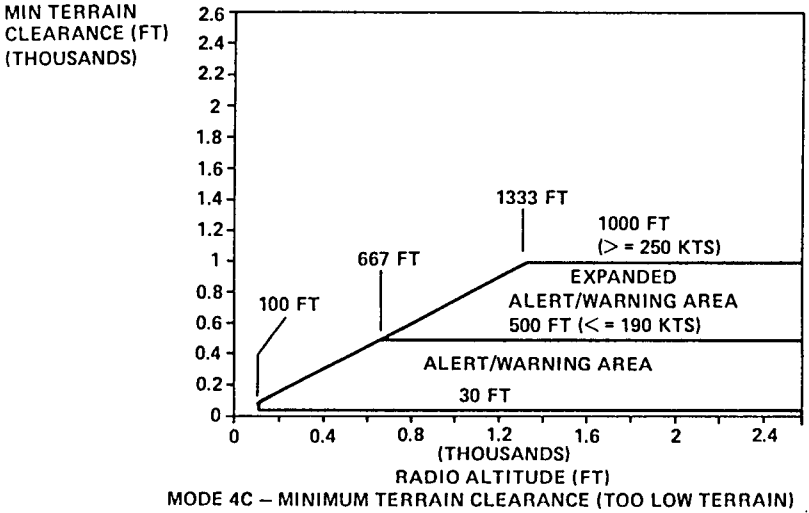
Mode 4 - Functional Block Diagram
Figure 017



MODE 4A – MINIMUM TERRAIN CLEARANCE (TOO LOW GEAR/TERRAIN)



MODE 4B – MINIMUM TERRAIN CLEARANCE (TOO LOW FLAPS/TERRAIN)



MODE 4C – MINIMUM TERRAIN CLEARANCE (TOO LOW TERRAIN)

BM6 34 48 00 0 CCU0 00

Mode 4 - Clearance Envelopes
Figure 018

**ON A/C 005-100,

Mode 4 generates 3 types of voice warnings based on radio altitude, computed airspeed and aircraft configuration. These are commonly referred to as modes 4A, 4B and 4C (Ref. Fig. 017) shows a block diagram of mode 4.

1 Modes 4A and 4B

The standard upper boundary for mode 4A is 500 feet radio altitude. If this boundary is penetrated with gear still up, the voice message is "TOO LOW GEAR" (or equivalent). At 190 kts airspeed, the upper boundary increases linearly with airspeed to a maximum of 1000 ft. radio altitude at 250 kts or more. Penetrating this boundary produces a message of "TOO LOW TERRAIN" (or equivalent). When the landing gear is lowered, the upper boundary decreases to 245 ft. This is reduced to 150 ft. on those aircraft types that routinely delay full flap deployment. This action is stored in nonvolatile memory to prevent inadvertent reactivation of the 500 ft. boundary during power loss. To maintain the same airspeed expansion function up to 1000 ft. nominal at 250 kts, the lower level 'corner' is at 159 kts. Penetration below 159 kts results in a message "TOO LOW GEAR" (or equivalent) with gear up or "TOO LOW FLAPS" (or equivalent) with gear down and flaps not in landing configuration. Above 159 kts the message is "TOO LOW TERRAIN" (or equivalent).

The Mode 4B envelope can be optionally selected by setting flaps to landing configuration if the alternate mode 4B activation logic has been selected. This provides the means to allow additional maneuvering room for marginal performance go-around (e.g. engine out) by selecting flap override.

The equation for the sloped portion of the alert/warning curves for both mode 4A and 4B is:

Min. terrain clearance (ft.) = -1083 ft. +8.333 x calibrated airspeed (kts)

Selection of program pin PPENH applies a ratchet function to the mode 4 voice warning. Once the message is given, the envelope is biased down by 20 % and further warnings are held off until this additional 20 % radio altitude is lost. The lamp is not affected and remains on until the radio altitude becomes greater than the depicted curves.

2 Mode 4C

Mode 4 also provides a warning based on minimum radio altitude clearance during take-off. This warning is similar to the mode 4A warning that is active during the cruise and approach phases of flight, only in this case, the minimum terrain clearance is a function of the radio altitude of the aircraft. The sloped portion of the envelope boundary is described by the equation:

Min. terrain clearance (ft.) = 0.75 x radio altitude (ft.)

It is based on an minimum terrain clearance, or floor, that increases with radio altitude during take-off. A value equal to 75 % of the current radio altitude is accumulated in a long term filter that is only allowed to increase in value. If the radio altitude should decrease later, the filter stores its maximum attained value. A further decrease in radio altitude below the stored filter value with gear or flaps up results in the warning "TOO LOW TERRAIN" (or equivalent).
This warning is provided to prevent inadvertent controlled flight into the ground during take-off climb into terrain that produces insufficient closure rate for a mode 2 warning. After take-off and mode change-over from take-off to cruise or approach, mode 4A or 4B provides this protection.
The filter is activated at 100 ft. radio altitude on take-off and continues until approach mode is activated or until the radio altitude decreases below 30 ft.
Selection of the PPENH program pin will apply a ratchet function to the mode 4C voice warning which is equivalent to the ratcheting voice message described above. Once the message is given, the envelope is biased down by 20 % and further warnings are held off until this additional 20 % radio altitude is lost. The lamp is not affected and will remain on until the terrain clearance problem is rectified.

(e)Mode 5 - Descent below glideslope

R **ON A/C 001-004,

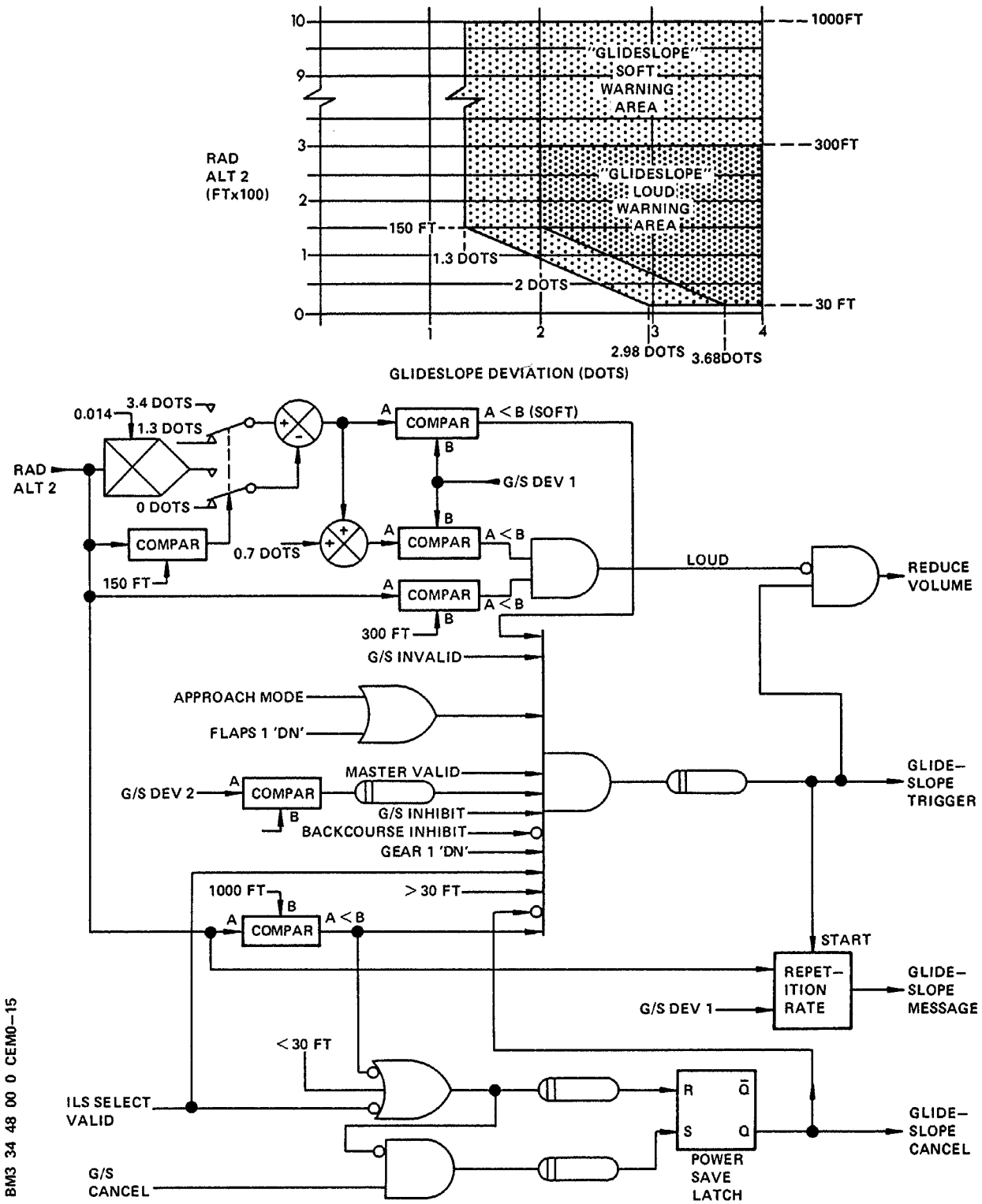
(Ref. Fig. 019)

**ON A/C 005-100,

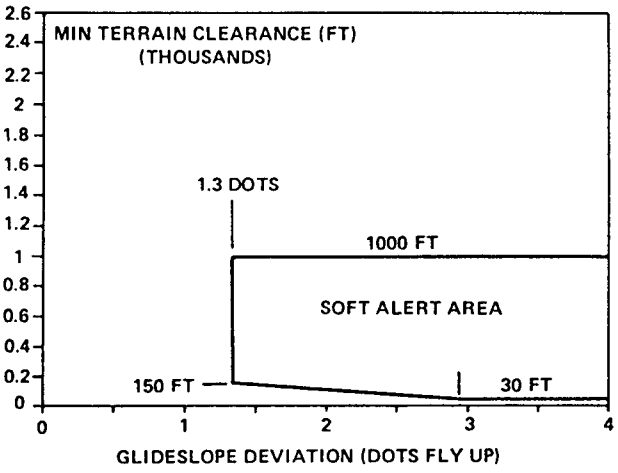
(Ref. Fig. 020)

R **ON A/C 001-004,

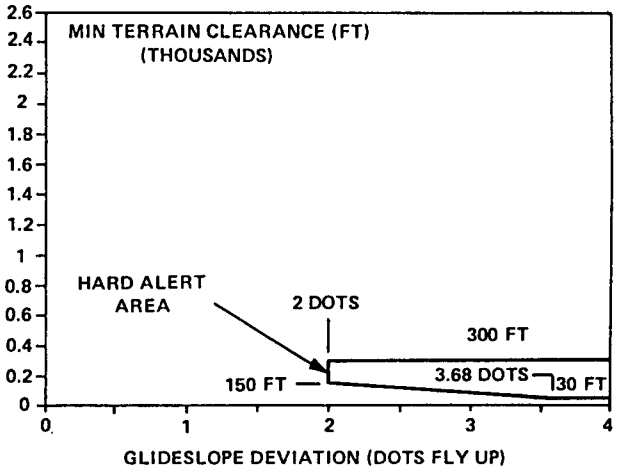
Mode 5 computations are based on 'rad. alt. 2' and 'G/S dev 1' and '2'. The warning boundary upper limit of 1000 ft. allows glideslope capture before mode 5 is enabled. The warning envelope comprises two regions. If the soft warning area is penetrated; reduced volume, glideslope and glideslope message triggers are produced, resulting in a low-volume, repeated 'GLIDESLOPE' aural warning. The warning repetition rate is a function of 'radio alt 2' and 'G/S dev 1' and increases with depth of penetration (refer to paragraph (4b)). If the loud warning area is penetrated; the reduce volume trigger is removed and the "GLIDESLOPE" warning volume is increased to the normal warning level.
The sloped portion of the warning envelope (below 150 ft.) minimises nuisance warnings due to glideslope beam instability near the runway threshold.
Mode 5 is automatically disabled by the "Backcourse inhibit" discrete to prevent glideslope warnings being triggered during backbeam



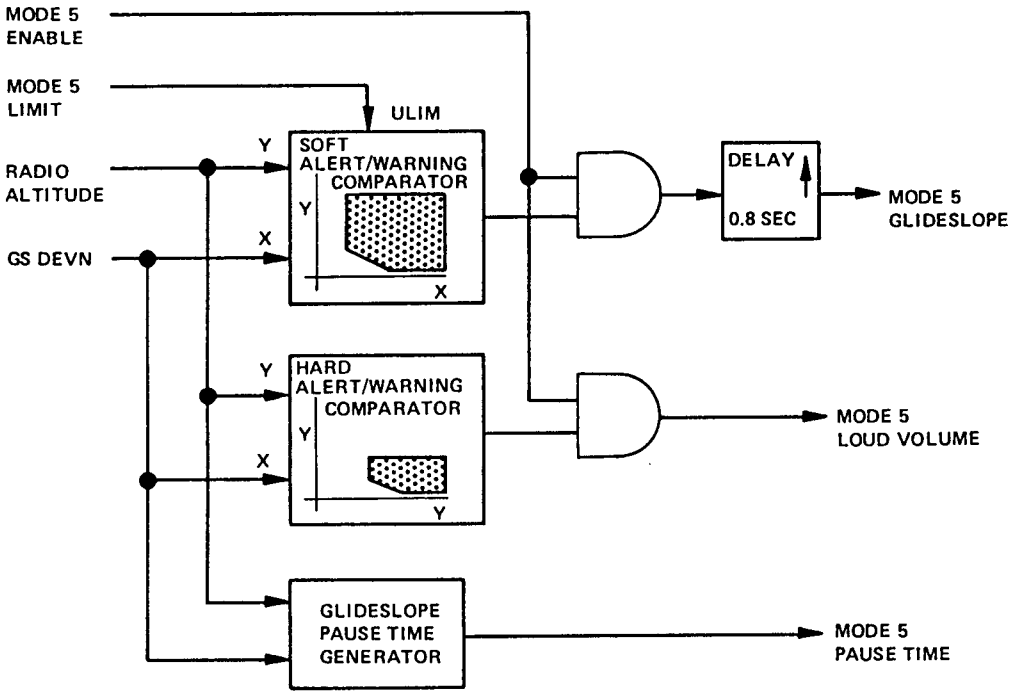
Mode 5 Warning Envelope and Modulation
Figure 019



MODE 5 – DESCENT BELOW GLIDESLOPE (SOFT GLIDESLOPE)



MODE 5 – DESCENT BELOW GLIDESLOPE (HARD GLIDESLOPE)



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Mode 5 - Warning Envelope and Modulation
Figure 020

approaches or during go-around manoeuvers.
Below 1000 ft the glideslope warnings can be cancelled by pressing the captain's or first officer's GPWS-G/S pushbutton switch light. It is automatically reset above 1000 ft.

**ON A/C 005-100,

Mode 5 provides 2 levels of warning when the aircraft flight path descends below the glideslope beam on front course ILS approaches. The upper limit for the 'soft glideslope' of 1000 ft. nominal allows capture of the beam before enabling this mode. Other upper limits are used at certain airports to improve alert/warning envelope protection. Deviation boundaries are shown in 'dots' below the beam (i.e., fly up) where 1 dot equals 0.0875 DDM.
The first warning occurs whenever the aircraft is more than 1.3 dots below the beam. This warning is called a 'soft' "GLIDESLOPE" warning because the volume level of the warning is approximately 1/2 (-6 dB) of the other warnings.
A second warning boundary occurs below 300 ft. altitude and below 2 dots deviation and is called a 'loud' or 'hard' "GLIDESLOPE" warning, because the volume level is increased to that of the other warnings.
Both boundaries allow additional deviation below 150 ft. radio altitude to allow for normal beam variations near the threshold. The equation for the sloped portion of the warning curve relating radio altitude and glideslope deviation (GS DEV) required for the soft warning is:

Min. terrain clearance (ft.) = 243 ft. + 71.43 x GS DEV (Dots Fly Up)

The equation for the hard warning is:

Min. terrain clearance (ft.) = 293 ft. + 71.43 x GS DEV (Dots Fly Up)

The repetition rate of the "GLIDESLOPE" messages is also varied as a function of radio altitude and glideslope deviation, being slow at 1000 ft. and 1.3 dots and increasing in speed as altitude decreases or deviation increases. Actual time between "GLIDESLOPE" messages is controlled by the equation:

Pause (s) = radio altitude (ft)/GS DEV (Dots Fly Up) x 0.0067

Mode 5 is improved with selection of the enhanced warning modes. A logic is provided which suppresses the aural alert after 1 message has been given. Follow-on alerts are only allowed when the aircraft descends lower on the glideslope beam by approximately 20 %. The alert lamp remains on until the excessive Fly-Up condition has been corrected. The aural alerts are provided continuously once the aircraft exceeds 2 dots Fly-Up.
The "GLIDESLOPE" warning can be manually cancelled by the crew by momentarily activating the glideslope mode manual inhibit discrete.
A delay of approximately 0.8 s is inserted between the alert

output and the enabling logic during a warning condition. The delay also turns off the warning output when 2 successive samples show a loss of enabling logic. The repetition rate of the "GLIDESLOPE" message is controlled by radio altitude and glideslope deviation as shown in the preceding equation.
Automatic ILS glideslope backcourse inhibit is provided when selected runway heading (or selected course) and track angle, magnetic are available. This prevents mode 5 nuisance alerts due to false fly up lobes during backcourse approaches.

1 Mode 6 - Altitude Call-Outs

Mode 6 is a program pin selectable option where an aural annunciation can be given when the aircraft descends below a minimum radio altitude selected by the pilot. This mode is also capable of annunciating predefined altitude callouts below 1000 feet and Bank Angle callouts. These callouts can be based on either a filtered version of radio altitude or QFE corrected altitude (selected with PPQFE program pin strap), which gives callouts based on altitude above field elevation. The QFE altitude option should only be used for operators that utilize QFE altitude correction in lieu of QNH altitude correction. Only aural annunciations are available for this mode. However, callout messages are encoded on ARINC 429 discrete output labels 270, 272, and 273.

Altitude callout messages are only activated between the associated value and a value 10 ft. less than this value (20 ft. when above 150 ft). Only one callout message is active at a time and subsequent callout messages can not be started until the current messages complete. In this manner, an effective callout priority is established. A memory function is utilized to lock out callouts once they have been issued or their associated altitude bands have been transitioned.

GENERAL CALLOUT OPTION	DESCRIPTION
LOW VOLUME	defaults all callouts to low volume
BANK ANGLE	provides bank angle callout
DECISION HEIGHT	provides decision height callout for descent below DH bug setting
MINIMUMS	provides "MINIMUMS" callout for descent below DH bug setting
MINIMUMS MINIMUMS	provides "MINIMUMS MINIMUMS" callout for descent below DH bug setting
APPROACHING DECISION HEIGHT	provides "APPROACHING DECISION HEIGHT" callout for descent below DH bug setting plus 100 ft.
APPROACHING MINIMUMS	provides "APPROACHING MINIMUMS" callout for descent below DH bug setting + 80 ft.
1000	provides "ONE THOUSAND" callout for descent below 1000 ft.

GENERAL CALLOUT OPTION	DESCRIPTION
500	provides "FIVE HUNDRED" callout for descent below 500 ft.
500 TONE	provides "2 SECOND 960 HZ TONE" callout for descent below 500 ft.
SMART CALLOUT	provides "FIVE HUNDRED" callout for descent below 500 ft., only given during non-precision approach
400	provides "FOUR HUNDRED" callout below 400 ft.
300	provides "THREE HUNDRED" callout below 300 ft.
200	provides "TWO HUNDRED" callout below 200 ft.
100	provides "ONE HUNDRED" callout below 100 ft.
100 TONE	provides "2 SECOND 700 HZ TONE" callout for descent below 100 ft.
80	provides "EIGHTY" callout below 80 ft.
60	provides "SIXTY" callout below 60 ft.
50	provides "FIFTY" callout below 50 ft.
40	provides "FORTY" callout below 40 ft.
35	provides "THIRTY FIVE" callout below 35 ft.
35 TONE	provides "1 SECOND 1400 HZ TONE" callout for descent below 35 ft.
30	provides "THIRTY" callout below 30 ft.
20	provides "TWENTY" callout below 20 ft.
20 TONE	provides "1/2 SECOND 2800 HZ TONE" callout for descent below 20 ft.
10	provides "TEN" callout below 10 ft.
0	provides "ZERO" callout below 1 ft.

The mode 6 "MINIMUMS MINIMUMS" or "MINIMUMS" or "DECISION HEIGHT" callouts are given when the aircraft is between 1000 ft. nominal and 10 ft. radio altitude with the landing gear down and the decision height discrete input switches to DC ground or the aircraft transitions less than the selected DH input.

A bank angle warning is provided to give a warning indication for inadvertent over-banking during all phases of flight. An aural warning consisting of two "BANK ANGLE" messages is given. Follow-on aural messages are only allowed when the aircraft roll angle increases an additional 20 % from the previous alert. The basic bank angle warning is based on the aircraft's roll angle versus altitude. This provides protection against over-banking during maneuvering on the approach or the climbout and while at altitude, and in addition protects against wing or engine strikes during landing.
When enabled, the 'Smart Callout' feature provides for a 500 ft.

callout that is only active during a non-precision approach. The 'Smart callout' feature can function with (or without) any of the normal altitude callouts. If the smart 500 callout is enabled, it will be given during an approach if any one or more of the following conditions are true:
- if the flight path is not within +/-2 dots of a valid glideslope beam,
- if the flight path is not within +/-2 dots of a valid localizer beam,
- if the backcourse approach is detected.

This callout option is not used if an altitude callout menu containing the normal 500 ft. callout is selected.

2 Mode 7 - Windshear Detection and Annunciation

Windshear detection and annunciation is an optional mode for the GPWC which is enabled by use of a program pin PPBWS. If the program pin is selected, two types of operation are possible. For some aircraft type, the mode 7 windshear detection alert/warning logic is based on an implementation of the SDC developed windshear algorithm. In other installations, the actual detection algorithm exists in other equipment and the MK V processes inputs from these systems to annunciate windshear.

Operation for Windshear Detection and Annunciation

Mode 7 windshear detection is active between 10 and 1500 ft. AGL during the initial take-off and final approach phases of flight. Alerts and warnings are provided when the level of windshear exceeds predetermined threshold values.
Windshear warnings are given for decreasing head wind (or increasing tail wind) and severe vertical downdrafts. Windshear alerts are given for increasing head wind (or decreasing tail wind) and severe updrafts.

The primary inputs for the mode 7 algorithm are as follows:
- Longitudinal Acceleration
- Normal Acceleration
- True Airspeed
- Body Angle of Attack
- Altitude Rate
- Roll Angle
- Radio Altitude
- Static Air Temperature
- Glideslope Deviation

The algorithm calculates a total windshear indication and does not resolve individual horizontal and vertical windshear components. The shear signal is modulated by radio altitude and roll angle in order to provide further margin against unwanted alerts which could potentially result from turning into and out of winds.
The total shear signal is then compared to thresholds which are a function of aircraft type to determine an excessive windshear condition. The thresholds are modulated as a function of static

air temperature, excess lift above reference velocity (during approach), and flight path angle. Once the modulated threshold has been exceeded, a siren is sounded, followed by the voice message "WINDSHEAR WINDSHEAR WINDSHEAR" (or equivalent). An output warning lamp is also activated upon exceeding the windshear threshold. This lamp remains on as long as the windshear condition exists, or as a minimum, 8 s.
The other GPWC modes are inhibited for a minimum of 5 s after a windshear warning.
Logic is provided to distinguish between the take-off and approach phases of flight. Slightly different enable logic and gain curves are used for detection in each of these phases of flight. The threshold value is also biased by 0.01 g for the take-off phase of flight reflecting the lower performance of the aircraft during this phase.
Mode 7 also provides an optional windshear caution or prealert as it is sometimes referred to, which is triggered for headwind and updraft conditions that typically exist on the leading edge of a microburst windshear. The windshear caution condition is maintained for a period of at least 8 s in order to prevent multiple alerts for a given event due to turbulence. This alert output is disabled when windshear warning conditions prevail.
A seperate discrete output is activated for this condition and no voice is given.

Operation for Windshear Annunciation Only
A windshear command input can be received from an external source on some aircraft types. Provisions are made to handle this command from two ARINC 429 input channels. Upon receiving the proper command word from either input channel the windshear warning condition is set true.
Once the warning output has been set, a siren is sounded, followed by the voice message "WINDSHEAR, WINDSHEAR, WINDSHEAR" (or equivalent). This message is given only once. At the end of the message, the warning output will be reset. Subsequent activations of the warning output will be inhibited for 30 s. In the event that a windshear command is received before this lock-out time has expired, the time remaining will be reset to 30 s with no warning output generated.
The windshear aural will have priority over all other ground proximity aurals. Other GPWC aurals will be inhibited for a minimum of 5 s after a windshear warning.

R **ON A/C 001-100,

(f)Envelope modulation
A number of airports throughout the world have approaches which are not entirely compatible with current ARINC 723 standard GPWS operation. To compensate for these runways, changes are necessary to some of the standard warning envelopes to ensure a reasonable approach at recognizable airports.

A reasonable approach altitude is verified by either:
- for Instrument Landing System (ILS) approaches, using glideslope and localizer deviations; or
- for non ILS approaches, using terrain and altitude matching.

Airport recognition is achieved by the following input data:
- latitude and longitude positions and aircraft magnetic heading from the Inertial Reference System (IRS);
- glideslope and localizer deviation and runway course from the ILS;
- corrected barometric altitude from the Air Data System (ADS);
- radio altitude; and
- barometric altitude correction of QNH (see level) or QFE (airport elevation) mode.

The following envelope modulations are required:

1 Mode 1 - bias the warning boundaries for 'sink rate' and 'pull up' to the right to allow greater barometric descent rates.

2 Modes 2A and 2B - lower the maximum closure rate to limit the maximum radio altitude or the minimum terrain clearance.

3 Mode 4 - lower the maximum airspeed expansion to provide lower minimum terrain clearance.

4 Mode 5 - expand the maximum radio altitude level to provide earlier warnings at higher radio altitudes and remove the gear down requirement to allow gear up warnings.

Airport runways which require envelope modulation, and the appropriate reasons for modulation, are as follows:

1 Hong Kong, B.C.C. - Instrument Guidance System approach to runway 13.
Shift Mode 1 'sinkrate' envelope 500FPM to the right and 'pull-up' envelope 200FPM to the right.

2 San Diego, Calif. - Localizer back course approach to runway 27.
Shift Mode 1 'sinkrate' envelope 500FPM to the right and 'pull-up' envelope 200FPM to the right.

3 Leeds Bradford, U.K. - Visual backcourse approach to runway 15 using localizer and airport surveillance radar. Terrain at approximately 2N miles from runway.
Limit Mode 2A and 2B to 2380FPM maximum to limit warnings to less than 300 feet radio altitude.

4 Lisbon, Portugal - ILS approach to runway 21. Terrain at approximately 6N miles from runway.
Limit Mode 2A to 3200FPM maximum to limit warnings to less than 947 feet radio altitude.

5 Ontario, Calif. - VOR approach to runway 26R. Jurupa Mountains at approximately 8N miles from runway.
Limit Mode 2A to 3200FPM maximum to limit warnings to less than 947 feet radio altitude.

6 Reno, Nevada - Backcourse approach to runway 34 using localizer and DME. Steamboat Hills at approximately 9N miles from runway.
Limit Mode 2A to 3200FPM maximum to limit warnings to less than 947 feet radio altitude.
Also limit Mode 4 to 950 feet maximum above 244 kts.

7 Seoul, Korea - VOR DME approach to runway 32. Terrain at approxi-

mately 11N miles from runway.
Limit Mode 2A to 3000FPM maximum to limit warnings to less than 789 feet radio altitude.
Also limit Mode 4 to 791 feet maximum above 226 kts.

8 St. John's Newfoundland - ILS approach to runway 16. Terrain at approximately 6N miles from runway.
Limit Mode 2A to 3200FPM maximum to limit warnings to less than 947 feet radio altitude

9 Vagar, Faroe Islands - Localizer DME approach to runway 13.
Island peak at outer marker, approximately 8.8N miles from runway.
Limit Mode 2A to 3200FPM maximum to limit warnings to less than 947 feet radio altitude.
Also limit Mode 4 to 950 feet maximum above 244 kts.

10 Victoria, British Columbia, Canada - Departure from runway 26.
Procedure turn on departure routes over peak terrain approximately 7N miles NW of airport.
Limit Mode 2A to 3520FPM maximum to limit warnings to less than 1200 feet radio altitude.

11 Zurich, Switzerland - ILS approach to runway 14. Terrain peak near outer marker.
Limit Mode 2A and Mode 2B to 2760FPM maximum to limit warnings to less than 600 feet radio altitude. Also limit Mode 4 to 600 feet maximum above 202 kts.

12 Hot Springs, Virginia - ILS approach to runway 24. Runway elevation 900 to 1700 feet above approach terrain.
Expand Mode 5 to 2000 feet maximum radio altitude and remove gear down requirement.

13 Kogoshima, Japan - ILS approach to runway 34. Runway elevation 200 to 900 feet above approach terrain.
Expand Mode 5 to 1500 feet maximum radio altitude and remove gear down requirement.

14 Paine Field, Washington - ILS approach to runway 16. Runway elevation 565 feet above water approach.
Expand Mode 5 to 1500 feet maximum radio altitude and remove gear down requirement.

15 Tenerife, Canary Islands - ILS approach to runway 30. Runway elevation 2000 feet above water approach.
Expand Mode 5 to 2000 feet maximum radio altitude and remove gear down requirement. Also expand Mode 4 to 2000 feet maximum for speeds above 370 kts.

16 Alicante, Spain - ILS/LOC approach to runway 11. Terrain peak at approximately 17N miles from runway.
Limit mode 2A to 3200 FPM maximum to limit warnings to less than 947 feet radio altitude.

17 Cuenca, Ecuador - ILS approach to runway 23. Terrain peak at approximately 5N miles from runway.
Limit Mode 2A to 3200 FPM maximum to limit warnings to less than 947 feet radio altitude.

18 Geneva, Switzerland - ILS approach to runway 5. Terrain peak at approximately 8N Miles from runway.
Limit Mode 2A to 3200 FPM maximum to limit warnings to less than

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947 feet radio altitude.

19 Quito, Ecuador - ILS/DME approach to runway 35. Terrain peak at approximately 5N miles from runway.
Limit Mode 2A to 3200FPM maximum to limit warnings to less than 947 feet radio altitude.

20 Quito, Ecuador - Departure from runway 17. Terrain peak at approximately 5N miles from runway.
Limit Mode 2A to 3520 FPM maximum to limit warnings to less than 1200 feet radio altitude.

21 Malaga, Spain - ILS approach to runway 14. Terrain peak at approximately 8N miles from runway.
Limit Mode 2A to 3200 FPM maximum to limit warnings to less than 947 feet radio altitude.

R **ON A/C 001-004,

NOTE : The existing envelope modulation at Madrid, Spain, for terrain peak at 3.6N miles from ILS approach to runway 13 is deleted. Operators will increase terrain clearance above the current minimum due to close proximity with terrain.

(3)Mode control logic (Ref. Fig. 013)
Modes 3 and 4 are mutually exclusive and, therefore, logic circuitry is necessary to determine the selection. All other modes are available at any time based on their individual requirements.

The inputs for Mode 3 'take-off mode' are:
- Flaps 2 down
- Gear 1 down
- Height less than 245 ft.

Mode 4 'approach mode' requires that the aircraft radio altitude should be in excess of 667 ft. The logic circuitry is enabled by a master valid signal and the mutually exclusive output is achieved by use of an R/S type latch. The latch also provides a safety factor, in that a wrong selection cannot be made in the event of a temporary loss of power. A 0.2 sec. time delay is introduced between selection and switching to prevent interference due to spiking.
The output of the filter incorporated in the Mode 3 logic circuitry is compared with the airspeed computation of Mode 4 logic to generate a > Mode 4 term for switching from Mode 3 to Mode 4. Should the filter output be less than the airspeed curve, mode switching will occur at filter value of 500 ft (i.e. 75% of 667 ft 'rad. alt.' approx), or, if the filter output is greater than the airspeed curve at 1000 ft. (i.e. 75% of 1333 ft 'rad. alt.' approx).
When the aircraft is above 667 ft. 'rad. alt.', Mode 4 is selected and is maintained until the warning mode is made redundant. This occurs during approach when, due to flaps and landing gear down signals, the aircraft passes thru the 245 ft. base without initiating a warning. At this time the GPWC disables Mode 4 and selects Mode 3. Mode 3 remains selected until the aircraft again climbs to 667 ft. 'rad. alt.', at which height Mode 4 is re-selected.

NOTE : The 'flaps 2' logic is forced to a 'down' state when aircraft height is below 30 ft. This ensures a Mode 3 selection during final approach and also when on the ground for replacement or installation of a new computer.

(4)Warning Generation and inhibit

**ON A/C 005-100,

NOTE : The existing envelope modulation at Madrid, Spain, for terrain peak at 3.6N miles from ILS approach to runway 13 is deleted. Operators will increase terrain clearance above the current minimum due to close proximity with terrain.

(3)Mode control logic (Ref. Fig. 014)

Modes 3 and 4 are mutually exclusive and, therefore, logic circuitry is necessary to determine the selection. All other modes are available at any time based on their individual requirements.

The inputs for Mode 3 'take-off mode' are:
- Flaps 2 down
- Gear 1 down
- Height less than 245 ft.

Mode 4 'approach mode' requires that the aircraft radio altitude should be in excess of 667 ft. The logic circuitry is enabled by a master valid signal and the mutually exclusive output is achieved by use of an R/S type latch. The latch also provides a safety factor, in that a wrong selection cannot be made in the event of a temporary loss of power. A 0.2 sec. time delay is introduced between selection and switching to prevent interference due to spiking.
The output of the filter incorporated in the Mode 3 logic circuitry is compared with the airspeed computation of Mode 4 logic to generate a > Mode 4 term for switching from Mode 3 to Mode 4. Should the filter output be less than the airspeed curve, mode switching will occur at filter value of 500 ft (i.e. 75% of 667 ft 'rad. alt.' approx), or, if the filter output is greater than the airspeed curve at 1000 ft. (i.e. 75% of 1333 ft 'rad. alt.' approx).
When the aircraft is above 667 ft. 'rad. alt.', Mode 4 is selected and is maintained until the warning mode is made redundant. This occurs during approach when, due to flaps and landing gear down signals, the aircraft passes thru the 245 ft. base without initiating a warning. At this time the GPWC disables Mode 4 and selects Mode 3. Mode 3 remains selected until the aircraft again climbs to 667 ft. 'rad. alt.', at which height Mode 4 is re-selected.

NOTE : The 'flaps 2' logic is forced to a 'down' state when aircraft height is below 30 ft. This ensures a Mode 3 selection during final approach and also when on the ground for replacement or installation of a new computer.

(4)Warning Generation and inhibit

R **ON A/C 001-100,

(Ref. Fig. 021)

R **ON A/C 001-004,

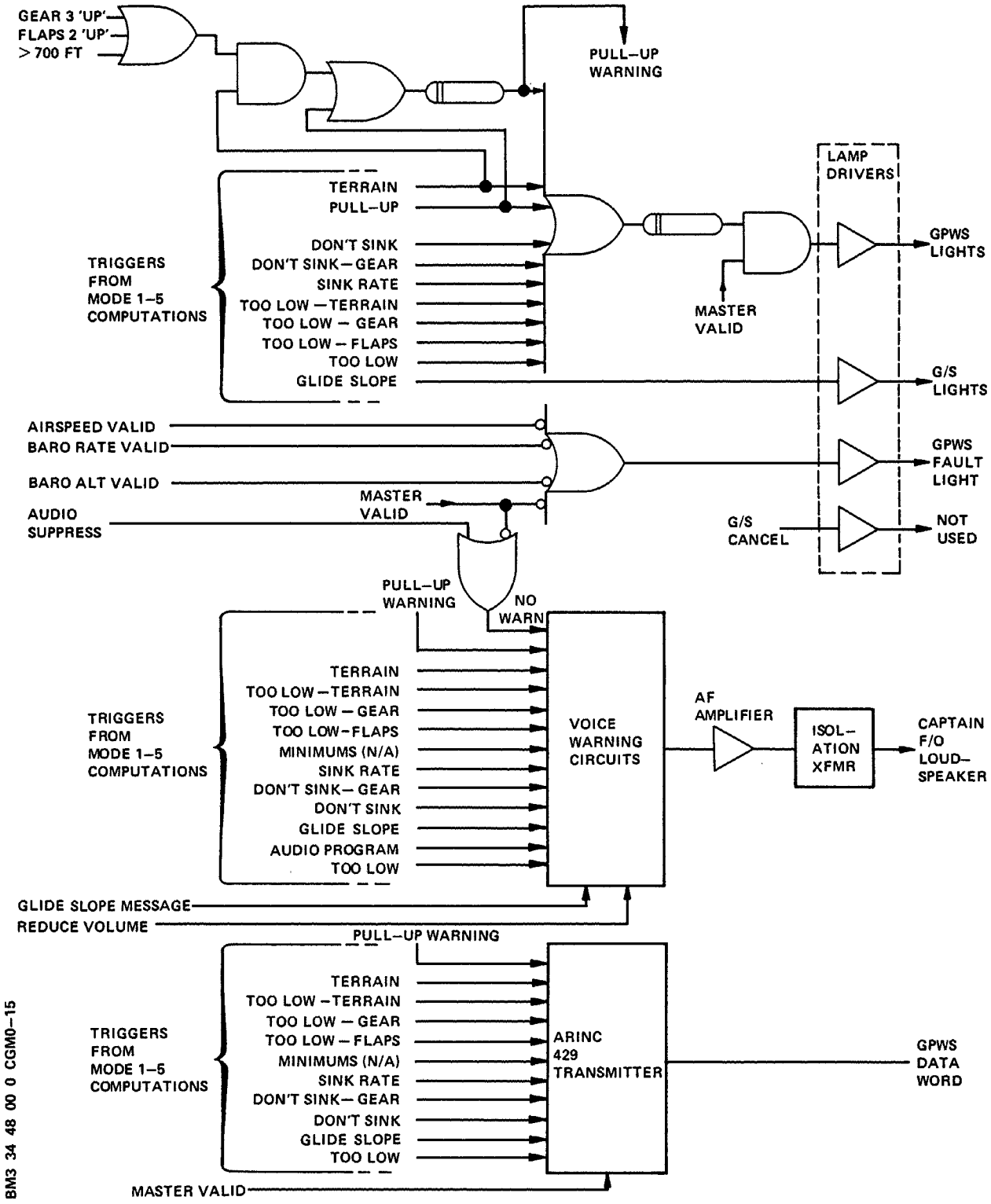
(a)Visual warnings
Warning triggers from mode 1-4 computations are applied to an OR circuit, the output of which is applied to the input of an AND gate after a 2 sample delay. If a mode 1, 2, 3 or 4 warning trigger is produced, and the internal generated master valid signal is present, a lamp driver provides a ground to the GPWS legend on the captain's and first officer's GPWS - G/S pushbutton switch lights.
The glideslope trigger from mode 5 computations is fed directly to a lamp driver which provides a ground to illuminate the G/S legend on the captain's and first officer's GPWS - G/S indicator lights.
The +DC supply for the indicator lights is normally provided by 28VDC busbar 111PP via circuit breaker 7WZ. Relays 263LT (captain) and 266LT (first officer) provide alternative supplies for dim operation.

(b)Aural Warnings
Warning triggers from mode 1-5 computations are applied to the voice warning circuits. If triggers from two or more modes are present, the highest priority trigger is accepted and the associated aural warnings are produced as defined by the audio program discrete. Aural warnings and priorities are as follows:

PRIORITY	TRIGGER	AURAL WARNING	MODE
1	No Warn	-	-
2		"WHOOP WHOOP PULL-UP"	1 and 2
3	Terrain	"TERRAIN" (See Note)	2
4	Too low	"TERRAIN"	3
5	Too low-terrain	"TERRAIN"	4
6	Too low-gear	"TERRAIN"	4
7	Too low-flaps	"TERRAIN"	4
8	N/A	N/A	6 (N/A)
9	Sink rate	"SINK RATE"	1
10	Don't sink gear	"SINK RATE"	3
11	Don't sink	"SINK RATE"	3
12	Glideslope	"GLIDESLOPE"	5

NOTE : In mode 2, after approximately 1.4 seconds of the "TERRAIN" aural warning, "WHOOP WHOOP, PULL-UP" is continuously broadcast until the envelope boundary is departed. Then the warning will revert to "TERRAIN" until the aircraft has climbed through 300 ft. of radio altitude.

The voice warning circuits also contain logic elements which ensure that:
- Only one message is produced at a time
- Higher priority messages interrupt lower priority messages
- A triggered message is completed even if warning condition ceases
- 0.75 second pause exists between warning messages.



Warning Generation and Inhibit
Figure 021

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(c)Glideslope triggers can be accompanied by reduce volume trigger (soft warning) and a glideslope message trigger. If the reduce volume trigger is present, the "GLIDESLOPE" aural output is set to approx. half the volume level (-6dB) of the other warnings. The glideslope message trigger defines the repetition rate of the "GLIDESLOPE" warning message according to the equation:

$$\text{Word duration} = \frac{\text{Radio Altitude} \times 0.0067}{\text{G/S deviation}}$$

Outputs from the voice warning circuits are processed by an isolation transformer and an audio amplifier to provide an 8 ohm impedance output for the flight compartment speakers.

(d)Warning inhibit

The voice warning circuits are inhibited by the priority 1 input (no warn - ref. para (2)). The priority 1 input is present if the internally generated 'master valid' signal is lost or the 'audio supress' discrete is present. If the 'master valid' signal is recovered or if the 'audio suppress' discrete is removed, the priority 1 input is cancelled and the previous warning will return (providing the associated warning envelope remains penetrated).

Visual warnings are inhibited by loss of 'master valid'.

Glideslope (mode 5) warnings only can be cancelled by pressing a GPWS - G/S pushbutton switch light.

(5)GPWC Maintenance Output

**ON A/C 005-100,

(a)Visual Warnings

Warning triggers from mode 1 to 4 computations are applied to an OR circuit, the output of which is applied to the input of an AND gate after a 2 sample delay. If a mode 1, 2, 3 or 4 warning trigger is produced, and the internally generated master valid signal is present, a lamp driver provides a ground to the GPWS legend on the captain's and first officer's GPWS - G/S pushbutton switch lights.

The glideslope trigger from mode 5 computations is fed directly to a lamp driver which provides a ground to illuminate the G/S legend on the captain's and first officer's GPWS - G/S indicator lights.

The +DC supply for the indicator lights is normally provided by 28 V DC from busbar 111PP via circuit breaker 7WZ. Relays 263LT (captain) and 266LT (first officer) provide alternative supplies for dim operation.

(b)Aural Warnings

Warning triggers from mode 1 to 7 computations are applied to the voice warning circuits. If triggers from two or more modes are present, the highest priority trigger is accepted and the associated aural warnings are produced as defined by the audio program discrete and according to the 'program pin strapping'. The basic aural warnings and priorities are as follows:

PRIORITY	TRIGGER	AURAL WARNING	MODE
1	Windshear Warning	(SIREN) WINDSHEAR WINDSHEAR WINDSHEAR	7

2	Pull Up	(WHOOP) (WHOOP) PULL-UP	1
3	Pull Up	(WHOOP) (WHOOP) PULL-UP	2
4	Pull Up Preface	TERRAIN TERRAIN	2
5	Terrain	TERRAIN	2
6	Minimums Minimums	MINIMUMS MINIMUMS	6
7	Minimums	MINIMUMS	6
8	Decision Height	DECISION HEIGHT	6
9	Too Low Terrain	TOO LOW TERRAIN	4
10	Altitude Callouts	VARIOUS ALTITUDE CALLOUTS	6
11	Smart Callout	(DISABLED)	6
12	Too Low Gear	TOO LOW GEAR	4
13	Too Low Flaps	TOO LOW FLAPS	4
14	Sink rate	SINK RATE SINK RATE	1
15	Don't Sink	DON'T SINK DON'T SINK	3
16	Glideslope	GLIDESLOPE	5
17	Approaching Minimums	APPROACHING MINIMUMS	6
18	Approaching Decision Height	APPROACHING DECISION HEIGHT	4
19	Bank Angle	BANK ANGLE BANK ANGLE	6
20	Windshear Alert	(QUIET)	7

NOTE : In mode 2, after approximately 1.4 s of the "TERRAIN" aural warning, "(WHOOP WHOOP) PULL-UP" is continuously broadcast until the envelope boundary is departed. Then the warning will revert to "TERRAIN" until the aircraft has climbed through 300 ft. of radio altitude.

The voice warning circuits also contain logic elements which ensure that:
- Only one message is produced at a time
- Higher priority messages interrupt lower priority messages
- A triggered message is completed even if warning condition ceases
- A 0.75 s pause exists between warning messages.

(c)Glideslope triggers can be accompanied by reduce volume trigger (soft warning) and a glideslope message trigger. If the reduce volume trigger is present, the "GLIDESLOPE" aural output is set to approx. half the volume level (-6dB) of the other warnings. The glideslope message trigger defines the repetition rate of the "GLIDESLOPE" warning message according to the equation:

$$\text{Word duration} = \frac{\text{Radio Altitude} \times 0.0067}{\text{G/S deviation}}$$

Outputs from the voice warning circuits are processed by an isolation transformer and an audio amplifier to provide an 8 ohm impedance output for the flight compartment speakers.

(d)Warning inhibit

The voice warning circuits are inhibited by the priority 1 input (no warn - ref. para (2)). The priority 1 input is present if the internally generated 'master valid' signal is lost or the 'audio

supress' discrete is present. If the 'master valid' signal is recovered or if the 'audio suppress' discrete is removed, the priority 1 input is cancelled and the previous warning will return (providing the associated warning envelope remains penetrated).
Visual warnings are inhibited by loss of 'master valid'.
Glideslope (mode 5) warnings only can be cancelled by pressing a GPWS - G/S pushbutton switch light.

(5)GPWC Maintenance Output

R **ON A/C 001-100,

(Ref. Fig. 022)
A maintenance output signal (label 270 Octal) is provided by the ARINC 429 transmitter. The transmitter converts the microprocessor parallel data to standard serial data for the Data Management Unit (DMU) of the aircraft integrated data system (AIDS).

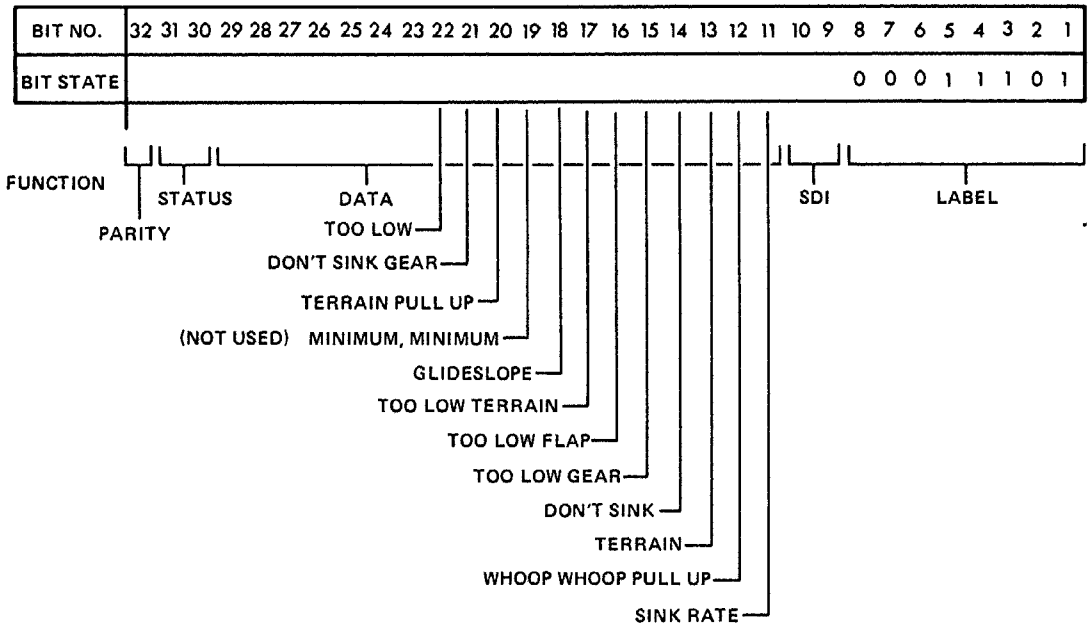
NOTE : A no warning condition shall result in all data bits, 11 thru 29, going to a logic zero state. Only one data bit at a time will be in logic one state, otherwise data shall be considered invalid.

C. Self Test
The GPWC interruptive self test facility provides the following test modes:
- Airborne self test
- Ground self test
- Ground vocabulary test
- Status/history test

(1)Airborne self test.
(a)Airborne self test mode is enabled when following conditions are met:
- radio altitude input is greater than 1000 ft. and valid, and the airspeed is above 90 knots.
- captain's or first officer's GPWS - G/S pushbutton switch is pressed.

(b)If no system faults are present, the GPWC generates the following warning sequence:
1 GPWS FAULT indicator comes on.
2 On both GPWS - G/S pushbutton switches the G/S legends come on and a (soft) "GLIDESLOPE" is broadcast.
3 G/S legends go off.
4 One "WHOOP WHOOP-PULL UP" warning is broadcast and on both GPWS-G/S pushbutton switches the GPWS legends come on.
5 At the end of the message the GPWS, G/S and GPWS FAULT lamps go off.

(2)Ground self test.
(a)The ground self test presents the same test sequence as the airborne test but it also includes an internal check. The internal test is enabled by a radio altitude input indicating an altitude below 30 ft. and the landing gear input indicating wheels down and locked. The test is initiated by pressing the captain's or first officer's GPWS-G/S pushbutton switch light for more than 0.5 seconds.
NOTE : Holding the switch depressed either for seven seconds minimum or again during the PULL-UP sequence of ground test initiates vocabulary test refer sub para C(3).



NOTE: THIS OUTPUT MAY OR MAY NOT CONTAIN WHOOP WHOOP DEPENDING ON THE STATUS OF ALTERNATIVE AUDIO ALERT SELECT DISCRETES NO. 1 THRU NO. 4

BM3 34 48 00 0 CJM0-15

GPWC Warning Mode and Maintenance Word Format
Figure 022

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(b)If the test is initiated and no faults are present the sequence starts. Between the first sequence step (GPWS-FAULT indicator comes on) and the second sequence step (G/S legends come on) an internal check is carried out on the following:
- Processor instruction set
- Program memory contents
- Voice memory contents

The internal check must not exceed four seconds.

(3)Ground vocabulary test

The ground vocabulary test also requires a radio altimeter input of less than 30 ft. and landing gear down and locked input. To initiate the test the captain's or first officer's GPWS - G/S pushbutton switch light is pressed either for seven seconds minimum or during the PULL-UP sequence of ground test.

NOTE : Failure to observe the above procedure will initiate ground test.

The test sequence is as follows.

(a)GPWS-FAULT indicator comes on.
(b)Verify self test input present for seven seconds minimum.
(c)Verify system status correct for ground test.
(d)Carry out internal checks as for ground check (Refer to sub para. C.(2)b.).
(e)Generate all aural warnings in the sequence:
"GLIDESLOPE"
"WHOOP-WHOOP PULL-UP"
"SINKRATE"
"WHOOP-WHOOP PULL-UP"
"TERRAIN"
"WHOOP-WHOOP PULL-UP"
"SINKRATE"
"TERRAIN"
"TERRAIN"
"GLIDESLOPE"
"MINIMUM"
(f)GPWS FAULT lamp goes off.

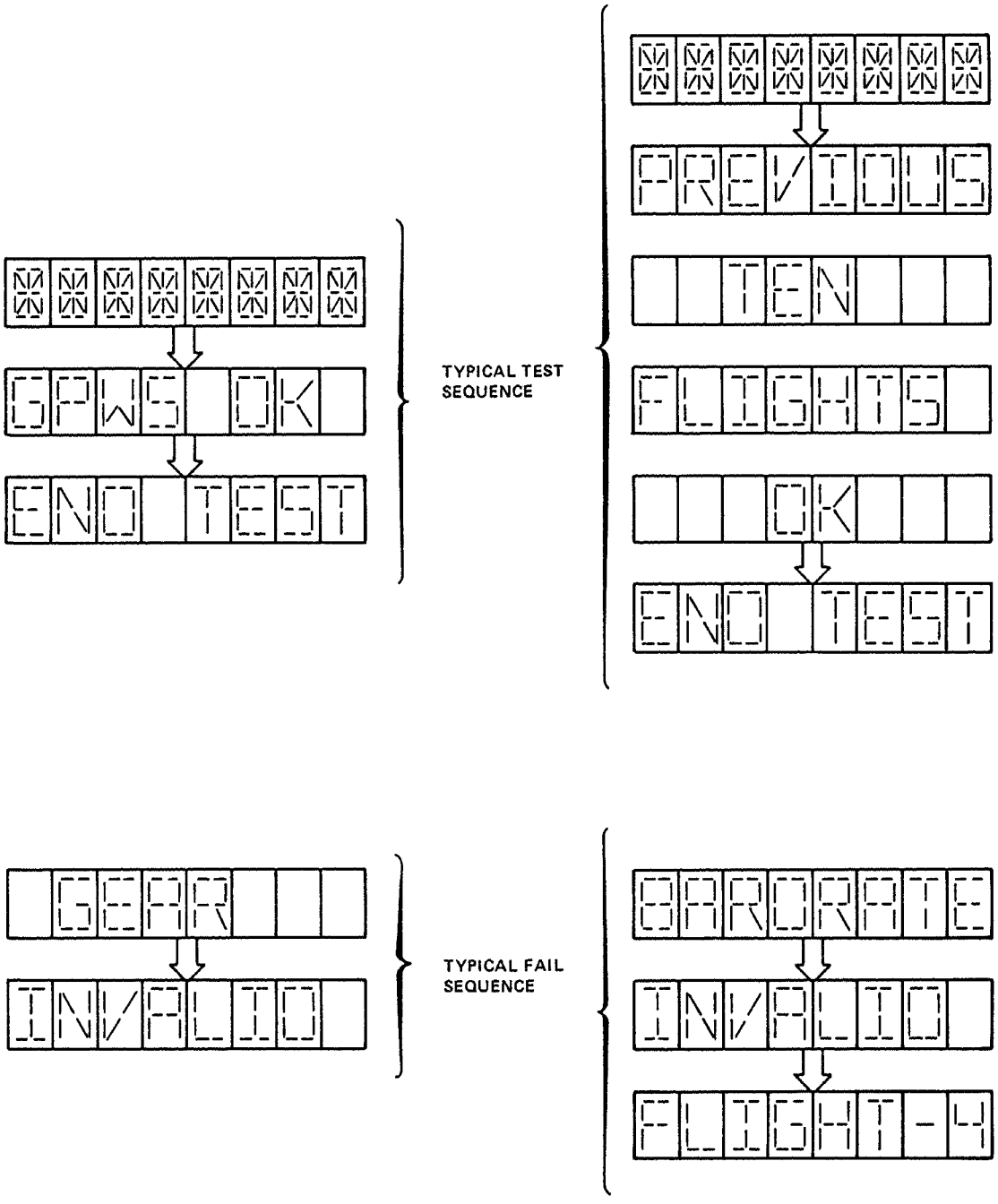
(4)Status/History test

(Ref. Fig. 023)

(a)The test is controlled by a STATUS/HISTORY switch and the results presented on an 8-character BITE display. Both are located on the front panel of the GPWC. The STATUS test is initiated by momentarily selecting PRESENT STATUS and the history test is initiated by momentarily selecting the switch to FLIGHT HISTORY. The test sequence begins with "ALL SEGMENTS TEST" and the final message presented will be "END TEST".

Computer failures are indicated by the display of "GPWC FAILED" or "FLT HIST INVALID". All other failure messages indicate an incorrect input condition.

(b)The desired information is read out of memory, converted to alpha-numeric data for presentation on the BITE display. The messages are presented using the following vocabulary:



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Status/History Test Readout
Figure 023

R **ON A/C 001-004,

IN TEST	INVALID	LAMPTEST
END TEST	INACTIVE	AUDIO
GPWS OK	INHIBIT	SELECT
GPWC	PREVIOUS	FLIGHT-0
RADIO	TEN	FLIGHT-1
ALTIMETR	FLIGHTS	FLIGHT-2
BARORATE	OK	FLIGHT-3
AIRSPEED	FAILED	FLIGHT-4
ALTITUDE	AIR DATA	FLIGHT-5
GLIDE	ILS DATA	FLIGHT-6
SLOPE	IRS DATA	FLIGHT-7
CANCEL	EXTERNAL	FLIGHT-8
COURSE	FLT HIST	FLIGHT-9
GEAR	INPUT	CORRECTD
RUNWAY	PROCESSR	LOCALIZR
HEADING	OUTPUT	LATITUDE
FLAPS	ASSEMBLY	LONGITUD
INERTIAL	SPEED	MAGNETIC
VERTICAL		

**ON A/C 005-100,

AIR DATA	FLIGHT-1	ILS	QFE
AIRSPEED	FLIGHT-2	IN TEST	QNH
ALTIMETR	FLIGHT-3	INACTIVE	RADIO
ALTITUDE	FLIGHT-4	INERTIAL	RUNWAY
ASSEMBLY	FLIGHT-5	INHIBIT	SELECT
AUDIO	FLIGHT-6	INPUT	SELECTED
BARO	FLIGHT-7	INVALID	SLOPE
BARORATE	FLIGHT-8	IRS	SOFTWARE
CANCEL	FLIGHT 9	LAMPTEST	SPEED
COMPUTED	FLIGHTS	LATITUDE	SYSTEM
CORRECTD	FLT HST	LOCALIZR	SPEED
DATA	FMC	LONGITUD	SYSTEM
END TEST	GEAR	MAG	TEN
EXTERNAL	GLIDE	MAGNETIC	TRACK
FAILED	GPWC	OK	VERSION
FAILURE	GPWS	OUTPUT	VERTICAL
FLAPS	HEADING	PREVIOUS	TRACK
FLIGHT 0	HISTORY	PROCESSR	

R **ON A/C 001-004,

(c)Possible examples for the status test are:

GPWS OK

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GEAR
INVALID

(d)Possible examples for history test are:

RADIO	BARORATE	ILS DATA
ALTIMETR	INVALID	INACTIVE
INACTIVE	FLIGHT-2	FLIGHT-3
FLIGHT-1		FLIGHT-4
FLAPS	PREVIOUS	
INVALID	TEN	
FLIGHT-8	FLIGHTS	
		OK

(e)No aural warnings are broadcast during the status/history test.
(f)The history test can be terminated, if there is a long history, by setting the **STATUS/HISTORY** switch to **PRESENT STATUS** until a blank appears. The display will change to **CANCEL** followed by **END TEST.** This operation will not alter the data in the flight history memory.

(5)Fault Messages

The following fault messages, together with their possible causes, can be displayed during present status or flight history tests:

MESSAGE	POSSIBLE CAUSE
NO DISPLAY	(a) Loss of GPWC power, 115 V AC, 400 Hz. (b) Internal GPWC failure
GPWS OK	(a) All inputs valid.
GPWC FAILED	(a) Internal GPWC failure.
RADIO ALTIMETR INACTIVE	(a) Loss of all data on radio altimeter bus inputs for min. 53 ms. (b) Open circuit or short to ground on one input wire for min. 53 ms.
RADIO ALTIMETR INVALID	(a) Loss of binary (BNR) label 164 (bus active). (b) Even parity data. (c) Failure warning code (bits 30 and 31=0). (d) No computed data (NCD) code below 2500 ft. (bit 30=1, bit 31=0). NOTE : Any of the above min. 160 ms.
AIR DATA INACTIVE	(a) Similar to RADIO ALTIMETER INACTIVE for air data bus: no data, open or short circuit.
BARORATE INVALID	(a) Loss of BNR label 212 (bus active). (b) Even parity data. (c) Failure warning code (bits 30 and 31=0) except for max. 7 s during Air Data Functional test. (d) NCD code - any value (bit 30=1, bit 31=0). NOTE : Any of the above for min. 197 ms.
ALTITUDE INVALID	(a) Similar to BARORATE INVALID except for BNR label 203.
CORRECTD ALTITUDE INVALID	(a) Similar to BARORATE INVALID except for BNR label 204.

**ON A/C 005-100,

(c)Possible examples for the status test are:

GPWS OK

GEAR
INVALID

(d)Possible examples for history test are:

RADIO	BARORATE	ILS DATA
ALTIMETR	INVALID	INACTIVE
INACTIVE	FLIGHT-2	FLIGHT-3
FLIGHT-1		FLIGHT-4
FLAPS	PREVIOUS	
INVALID	TEN	
FLIGHT-8	FLIGHTS	
	OK	

(e)No aural warnings are broadcast during the status/history test.
(f)The history test can be terminated, if there is a long history, by setting the STATUS/HISTORY switch to PRESENT STATUS until a blank appears. The display will change to CANCEL followed by END TEST. This operation will not alter the data in the flight history memory.

(5)Fault Messages

The following fault messages, together with their possible causes, may be displayed during present status or flight history tests:

MESSAGE	POSSIBLE CAUSE
IRS MAG TRACK INVALID	(a) ARINC 429 and analog input signal failure. (b) ARINC 704 or AHRS magnetic track/ heading failed.
GLIDE SLOPE INVALID	(a) ARINC 429 and analog input signal failure. (b) Left side ARINC 710/DAU #1 glide-slope deviation failed.
RUNWAY COURSE INVALID	(a) ARINC 429 and analog input signal failure. (b) Left side ARINC 710 selected runway heading failed.
LOCALIZR INVALID	(a) ARINC 429 and analog input signal failure. (b) Left side ARINC 710/DAU #1 localizer deviation failed.
FMC LATITUDE INVALID	(a) ARINC 429 and analog input signal failure. (b) Left side ARINC 702/IOC #1 latitude failed.
FMC LONGITUD INVALID	(a) ARINC 429 and analog input signal failure. (b) Left side ARINC 702/IOC #1 longitude failed.
FMC MAG TRACK INVALID	(a) ARINC 429 and analog input signal failure. (b) ARINC 702 magnetic track angle failed.
FLAPS INVALID	(a) Input discrete failure. (b) Landing flap failed.
GEAR INVALID	(a) Input discrete failure. (b) Landing gear failed.
GLIDE SLOPE CANCEL INVALID	(a) Input discrete failure. (b) Glideslope cancel failed.

MESSAGE	POSSIBLE CAUSE
AUDIO CANCEL INVALID	(a) Input discrete failure. (b) Momentary audio suppress failed.

R **ON A/C 001-004,

AIRSPEED INVALID	(a) Loss of BNR label 206 (bus active). (b) Even parity data. (c) Failure warning code (bits 30 and 31=0) except for max. 7 s during Air Data Functional test. NOTE : Any of the above for min. 393 ms. NOTE : NCD code (bit 30=1, bit 31=0). Normal - no message.
ILS DATA INACTIVE	(a) Similar to RADIO ALTIMETER INACTIVE for ILS bus; no data, open or short circuit, except for max. 106 ms.
GLIDE SLOPE INVALID	(a) Loss of BNR label 174 (bus active). (b) Even parity data. (c) Failure warning code (bits 30 and 31=0). except for max. 4 s during ILS Functional Test. (d) NCD code (bit 30=1, bit 31=0). Normal - no message. NOTE : Any of the above for min. 209 ms.
LOCALIZR INVALID	(a) Similar to GLIDESLOPE INVALID except for BNR label 173.
RUNWAY COURSE INVALID	(a) Loss of BCD label 017 (bus active). (b) NCD code - any value (bit 30=1, bit 31=0). NOTE : Either of the above for min. 1044 ms.
IRS DATA INACTIVE	(a) Similar to RADIO ALTIMETER INACTIVE for IRS bus: no data, open or short circuit.

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MESSAGE	POSSIBLE CAUSE
MAGNETIC HEADING INVALID	(a) Loss of BCD label 014 (bus active) for min. 1573 ms. (b) NCD code (bit 30=1, bit 31=0). Normal - no message.
LATITUDE INVALID	(a) Loss of BNR label 310 (bus active). (b) Even parity data. (c) Failure warning code (bits 30 and 31=0). (d) NCD code (bit 30=1, bit 31=0). Normal - no message. NOTE : Any of the above for min. 614 ms.

**ON A/C 005-100,

FLT HIST INVALID	(a) Fault history data failure.
PREVIOUS TEN FLIGHTS GPWS OK	(a) No faults in flight history.
FLIGHT-1 (2,3,...10)	(a) Flight leg count for flight history.
GPWS OK	(a) No GPWC or input failures exist.
GPWS FAILED FFFF	(a) GPWC internal failure. (b) The four character hexadecimal display in the place of *FFFF* indicates the type of BITE failure.
RADIO ALTIMETR INACTIVE	(a) ARINC 429 bus activity. (b) ARINC 707 radio altimeter bus #1 inactive.
AIR DATA INACTIVE	(a) ARINC 429 bus activity. (b) ARINC 706 DADC bus inactive.
IRS DATA INACTIVE	(a) ARINC 429 bus activity. (b) ARINC 704 IRS bus inactive.

MESSAGE	POSSIBLE CAUSE
R **ON A/C 001-004,	
LONGITUD INVALID	(a) Similar to LATITUDE INVALID except for BNR label 311.
GLIDE SLOPE CANCEL INVALID	(a) Continuous cancel for more than 15 s with aircraft on the ground.
AUDIO CANCEL INVALID	(a) Continuous cancel for more than 10 s GPWS FAULT lamp comes on if aircraft is on the ground.
EXTERNAL GPWC INHIBIT	(a) All modes inhibit activated by stall warning. Present status only, no flight history. Includes GPWC to OFF.
GEAR INVALID	(a) Gear discrete down above 65 ft. 'rad. alt.' and above 350 kts. airspeed for more than 696 ms. NOTE : Above fault in flight will inhibit self-test and turn on fail light when aircraft lands. Reactivation of normal self-test and fail light off will occur after flight history is read out or aircraft takes off on new flight. (b) Gear discrete up below 10 ft. 'rad. alt.' for more than 696 ms. Present status only, no flight history.
FLAPS INVALID	(a) Landing flap discrete down above 65 ft. 'rad. alt.' and above 350 kts airspeed for more than 696 ms. Includes override on. (b) Landing flap discrete up between 100 and 50 feet on approach resulting in flap warning. NOTE : Same as GEAR INVALID.
AUDIO SELECT	(a) More than one vocabulary select program pin activated at the same time.

MESSAGE	POSSIBLE CAUSE
INVALID	
FLT HIST INVALID	(a) Flight history data invalid. Data does not match checksum. GPWC at fault.

**ON A/C 005-100,

ILS DATA INACTIVE	(a) ARINC 429 bus activity. (b) ARINC 710 ILS #1 bus inactive.
FMC DATA INACTIVE	(a) ARINC 429 bus activity. (b) ARINC 702 FMC #1 bus inactive.
RADIO ALTITUDE INVALID	(a) ARINC 429 and analog input signal failure. (b) Left side ARINC 707 radio altitude failed. (c) ARINC 552 radio altitude failed. (d) Left side RAC-870 radio altitude failed.
BARORATE INVALID	(a) ARINC 429 and analog input signal failure. (b) ARINC 706 barometric altitude rate failed.
BARO ALTITUDE INVALID	(a) ARINC 429 and analog input signal failure. (b) ARINC 706 uncorrected barometric altitude failed.
COMPUTED AIRSPEED INVALID	(a) ARINC 429 and analog input signal failure. (b) ARINC 706 CAS failed.
CORRECTD ALTITUDE INVALID	(a) ARINC 429 and analog input signal failure. (b) ARINC 706 corrected barometric altitude failed.
INERTIAL VERTICAL SPEED INVALID	(a) ARINC 429 and analog input signal failure. (b) ARINC 704 or AHRS IVS failed.
IRS LATITUDE	(a) ARINC 429 and analog input signal failure.

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MESSAGE	POSSIBLE CAUSE
INVALID	(b) ARINC 704 latitude failed.
IRS LONGITUD INVALID	(a) ARINC 429 and analog input signal failure. (b) ARINC 704 latitude failed.

R **ON A/C 001-004,

The following faults can only occur during functional testing of the GPWC at a repair facility using the GPWS test set.

MESSAGE	POSSIBLE CAUSE
IN TEST	(a) Internally controlled test sequence is in progress.
PROCESSR ASSEMBLY FAILED	(a) A failure was detected in the processor circuit board assembly during sequential testing (ATP).
INPUT OUTPUT ASSEMBLY FAILED	(a) A failure was detected in the input output circuit board assembly during sequential testing (ATP).

**ON A/C 005-100,

General messages:

MESSAGE	POSSIBLE CAUSE
IN TEST	(a) General message during front panel status test sequence.
SOFTWARE VERSION IS XXXXXXX	Software version
END TEST	(a) General message during front panel status test sequence.
CANCEL	(a) General message during front panel status test sequence.

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MESSAGE	POSSIBLE CAUSE
QFE	(a) Program QFE/QNH altitude correction.
SELECTED	(b) QFE is selected.
EXTERNAL	(a) Program audio suppress inhibit.
GPWS	(b) Audio suppress inhibit discrete.
INHIBIT	(c) Inhibit selected, inhibit discrete active.

**ON A/C 101-200,

ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)
DESCRIPTION AND OPERATION

**ON A/C 101-200,

R Post SB 34-2188 For A/C 101-200,

1. General

The purpose of the Enhanced Ground Proximity Warning System (EGPWS) is to help prevent Controlled Flight Into Terrain (CFIT). The system achieves this objective by accepting a variety of aircraft parameters as inputs, applying alerting algorithms, and providing the flight crew with aural alert messages and visual annunciations and displays in the event that the boundaries of any alerting envelope are exceeded.

Enhanced features have been added to existing basic Ground Proximity Warning modes 1 to 5 which are the backbone of the system. The primary design objective has been to maintain the integrity of these modes independent of the other functions. For example, loss of the Terrain Awareness Display (TAD) function does not affect the operation of the basic GPWS modes. Also, loss of basic GPWS modes does not affect TAD function.

The following illustration provides an overall system block diagram. (Ref. Fig. 001)

The system comprises the following groups of components :

- aircraft sensors and other systems providing input signals,
- the Enhanced Ground Proximity Warning Computer (EGPWC),
- flight deck audio systems (speakers),
- alert lamps,
- EFIS Navigation Display (ND) for display of terrain,
- switching relays for switching display outputs from weather display to terrain display.

  Several main alerting functional areas are integrated into the EGPWC, which is a single Line Replaceable Unit (LRU). Except for basic GPWS, each function is pin selectable.

  The functional areas are :
- basic Ground Proximity Warning System (GPWS) (Modes 1 to 5),
- Terrain Clearance Floor function (TCF),
- Terrain Awareness and Display (TAD) function.

A. Basic GPWS modes

The basic GPWS modes generate aural and visual warnings if the aircraft

adopts a potentially hazardous condition with respect to :
Mode 1 - Excessive rate of descent.
Mode 2 - Excessive closure rate with terrain.
Mode 3 - Descent after takeoff and minimum terrain clearance.
Mode 4 - Unsafe terrain clearance.
Mode 5 - Descent below glide slope.

B. Enhanced Features
The EGPWC includes enhanced features which complete the basic GPWS modes.

(1)Terrain Clearance Floor (TCF) function
The Terrain Clearance Floor (TCF) function adds and additional element of protection to the basic GPWS modes. It creates an increasing terrain clearance envelope around the intended airport runway directly related to the distance from the runway. TCF alerts are based on current aircraft location, nearest runway center point position and radio altitude. TCF is active during takeoff, cruise and final approach. This alert mode complements existing Mode 4 protection by providing an alert based on insufficient terrain clearance even when in landing configuration. TCF function generates aural and visual alert.

(2)Terrain Awareness alerting and Display (TAD)
A major new feature of the EGPWS is the incorporation of the terrain awareness alerting and display functions. These functions use aircraft geographic position, aircraft altitude and a terrain database to predict potential conflicts between the aircraft flight path and the terrain, and to provide graphic displays of the conflicting terrain, as illustrated by the block diagram.
(Ref. Fig. 002)
The terrain awareness alerting algorithms continuously compute terrain clearance envelopes ahead of the aircraft. If the boundaries of these envelopes conflict with terrain elevation data in the terrain database, then alerts are issued. Two envelopes are computed, one corresponding to a Terrain Caution Alert level and the other to a Terrain Warning Alert level.
The algorithms are designed to meet the following criteria :
- operational Compatibility - Minimal unwanted alerts during normal flight operations and approach procedures,
- improved Terrain Awareness Warning Times - Provide adequate alert times for all flight phases and conditions,
- robustness - Tolerant of aircraft position errors, altitude signal errors and database errors.

The EGPWS computer outputs a display of terrain data in weather radar format per ARINC- 708/708A (ARINC 453) bus format. The terrain data can be displayed on the electronic Navigation Display (ND).
When the Terrain Display is present, it replaces the Weather Radar display. The Terrain Display can be made available to the flight crew at any time. When the conditions for either a Terrain Caution or Terrain Warning are detected, the EGPWS automatically switches flight deck displays between the Weather Radar and the Terrain Display. Both pilots can manually select Terrain Display or Weather Radar Display

using TERR ON ND switches at any time, even if an alert is in progress.

**ON A/C 101-200,

**ON A/C 101-200,

Post SB 34-2206 For A/C 101-200,

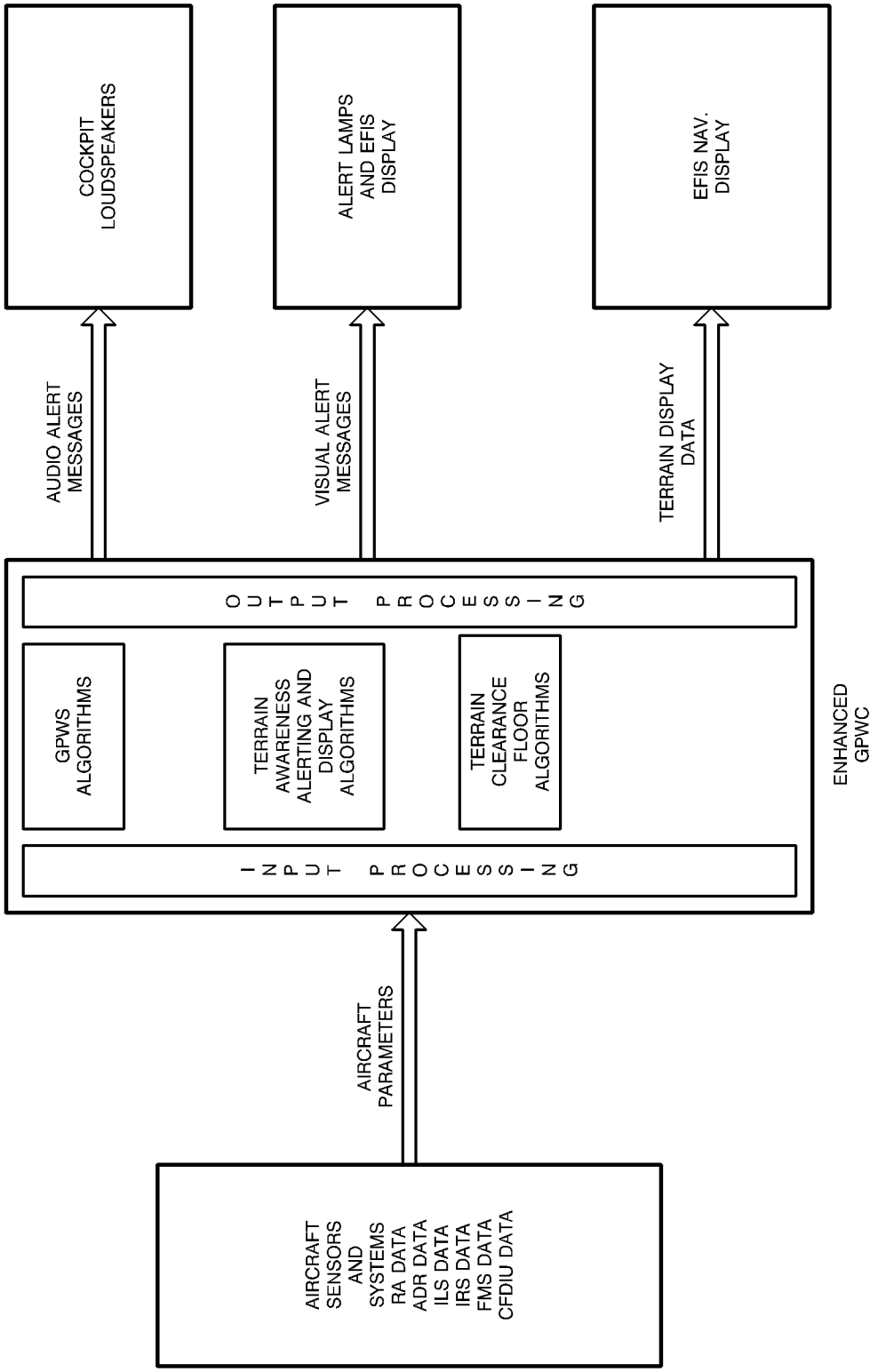
C. Additional Features

(1)Geometric Altitude:

Geometric Altitude is a computed aircraft altitude designed to help ensure optimal operation of the Enhanced GPWS TAD function through all phases of flight and atmospheric conditions.
Geometric Altitude uses an improved pressure altitude calculation, GPS altitude, radio altitude, and terrain and runway elevation data to reduce or eliminate errors potentially induced in corrected barometric altitude by temperature extremes, non standard altitude conditions and, altimeter mis-sets.

(2)GPS position:

When available on board, Enhanced GPWS uses preferably GPS, then IRS latitude and longitude data as valid position source and, if these positions are downgraded, then FMS position will be used.
When Enhanced GPWS is pin programmed to used GPS position, then Geometric Altitude is also activated.



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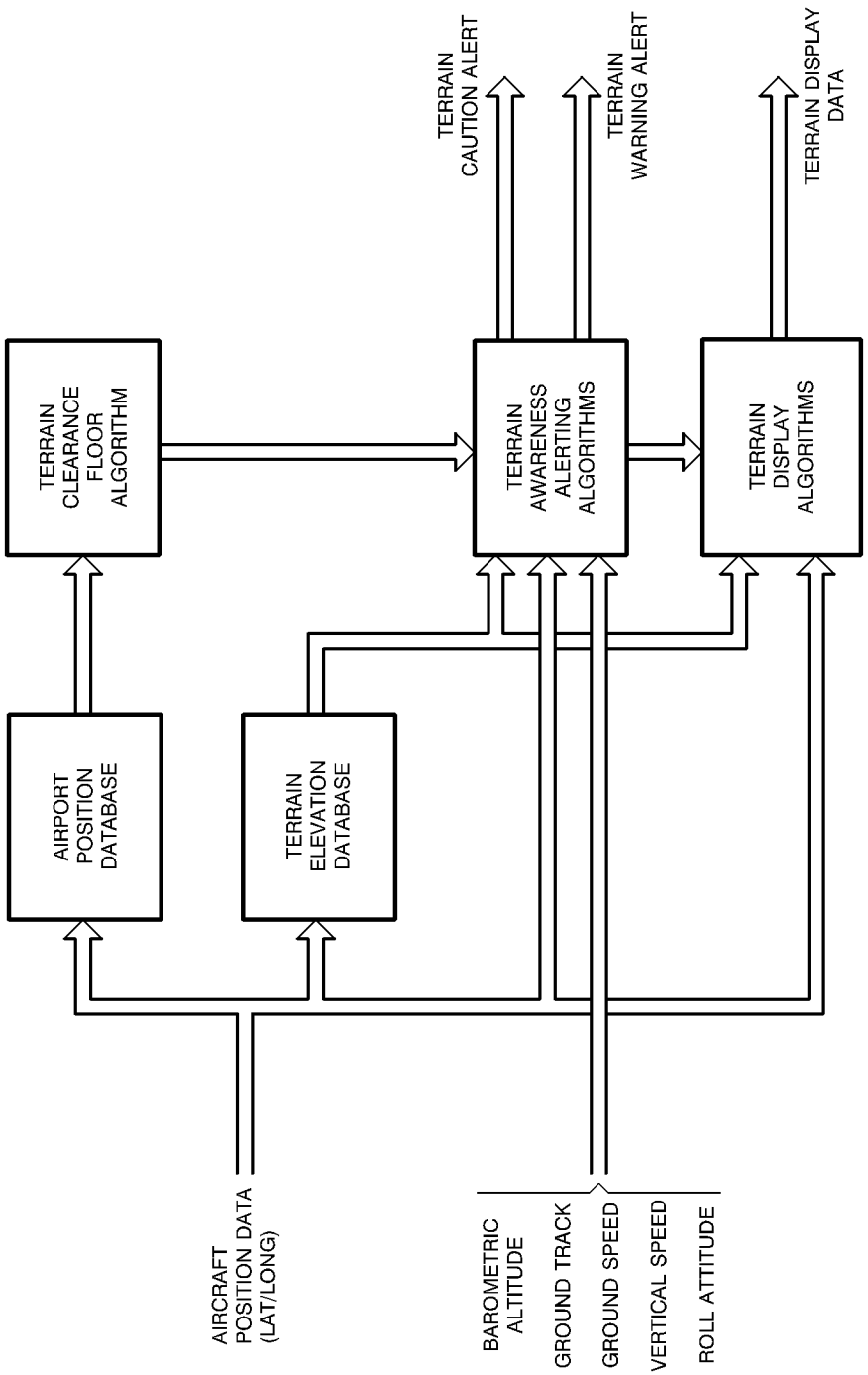
EGPWS - Enhanced Ground Proximity Warning System
Figure 001



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EGPWS - Terrain Awareness Functions
Figure 002

**ON A/C 101-104,

2. Component Location

ITEM	NAME	PANEL ZONE	ACCESS DOOR
1WZ	EGPWC	86VU 121	
2WZ	MOUNT - EGPWC	86VU 121	
3WZ	IND LT - GPWS/G/S, CAPT	3VU 211	
4WZ	IND LT - GPWS/G/S, F/O	5VU 212	
6WZ	C/B - GPWS/CMPTR	21VU 210	
7WZ	C/B - GPWS/WARN	21VU 210	
12WZ	SW - NORM/FLAP OVRD/OFF	402VU 211	
23WZ	SW - GPWS/LANDING/SLATS/FLAPS	409VU 212	
24WZ	ANN - GPWS	402VU 211	
30WZ1	P/BSW - TERR, CAPT	497VU	
30WZ2	P/BSW - TERR, F/O	498VU	
31WZ	P/BSW - TERR MODE	402VU	
32WZ	RELAY - WXR2/TERR DATA SWITCHING, F/O	81VU	
33WZ	RELAY - WXR1/TERR DATA SWITCHING, CAPT	81VU	
34WZ	RELAY - WXR1/TERR DATA SWITCHING, F/O	81VU	
35WZ	RELAY - WXR2/TERR DATA SWITCHING, CAPT	81VU	
36WZ	RELAY - STBY INDICATION COMMAND	81VU	

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

2. Component Location

ITEM	NAME	PANEL ZONE	ACCESS DOOR
1WZ	EGPWC	86VU 121	
2WZ	MOUNT - EGPWC	86VU 121	
3WZ	IND LT - PULL UP/GPWS, CAPT	3VU 211	
4WZ	IND LT - PULL UP/GPWS, F/O	5VU 212	
6WZ	C/B - GPWS/CMPTR	21VU 210	
7WZ	C/B - GPWS/WARN	21VU 210	
12WZ	SW - NORM/FLAP OVRD/OFF	402VU 211	
23WZ	SW - GPWS/LANDING/SLATS/FLAPS	409VU 212	
24WZ	ANN - GPWS	402VU 211	
30WZ1	P/BSW - TERR, CAPT	497VU	

ITEM	NAME	PANEL ZONE	ACCESS DOOR
30WZ2	P/BSW - TERR, F/O	498VU	
31WZ	P/BSW - TERR MODE	402VU	
32WZ	RELAY - WXR2/TERR DATA SWITCHING, F/O	81VU	
33WZ	RELAY - WXR1/TERR DATA SWITCHING, CAPT	81VU	
34WZ	RELAY - WXR1/TERR DATA SWITCHING, F/O	81VU	
35WZ	RELAY - WXR2/TERR DATA SWITCHING, CAPT	81VU	
36WZ	RELAY - STBY INDICATION COMMAND	81VU	

**ON A/C 101-104,

(Ref. Fig. 003)

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

(Ref. Fig. 004)

**ON A/C 101-200,

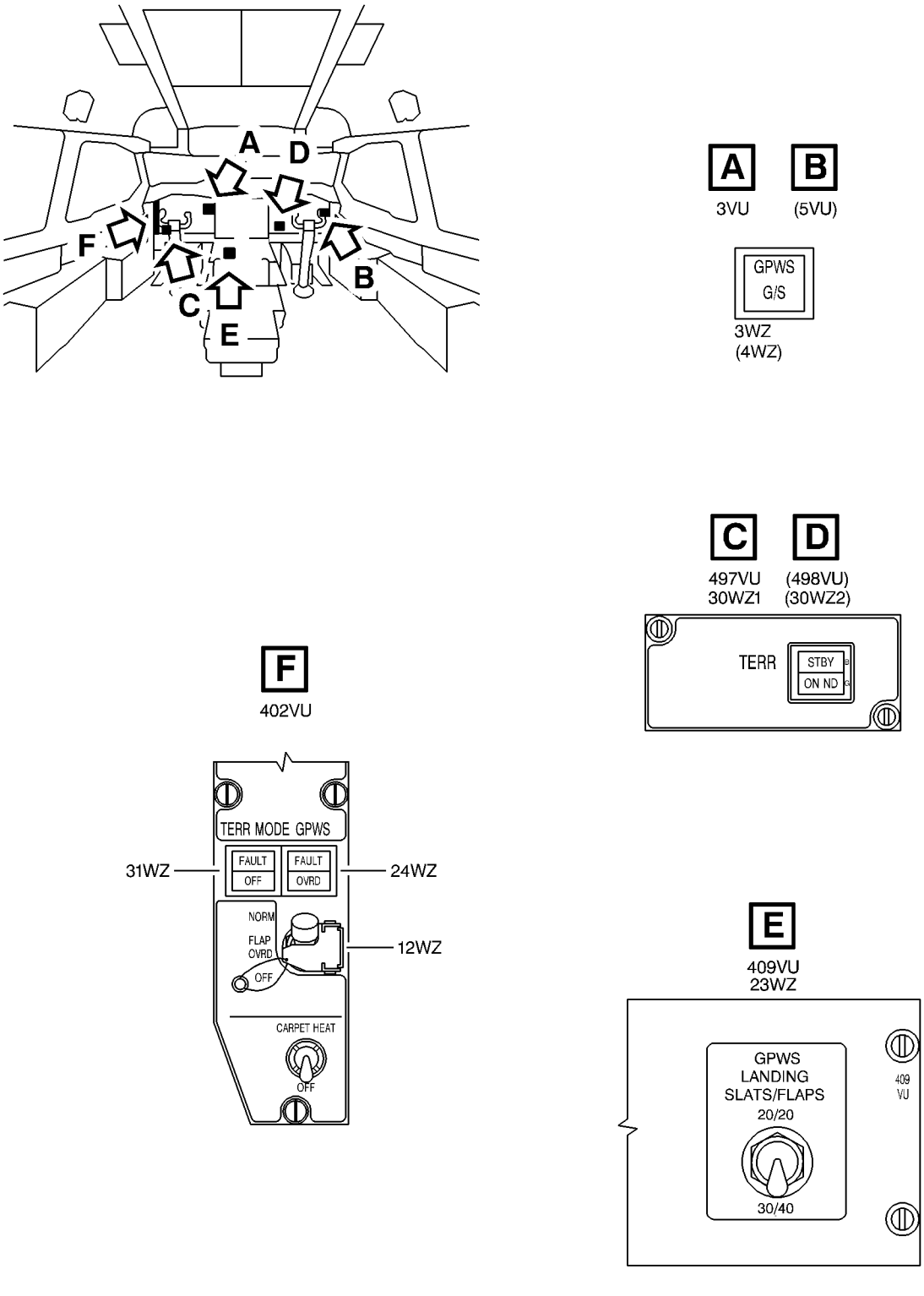
(Ref. Fig. 005)

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

(Ref. Fig. 006)

**ON A/C 101-200,



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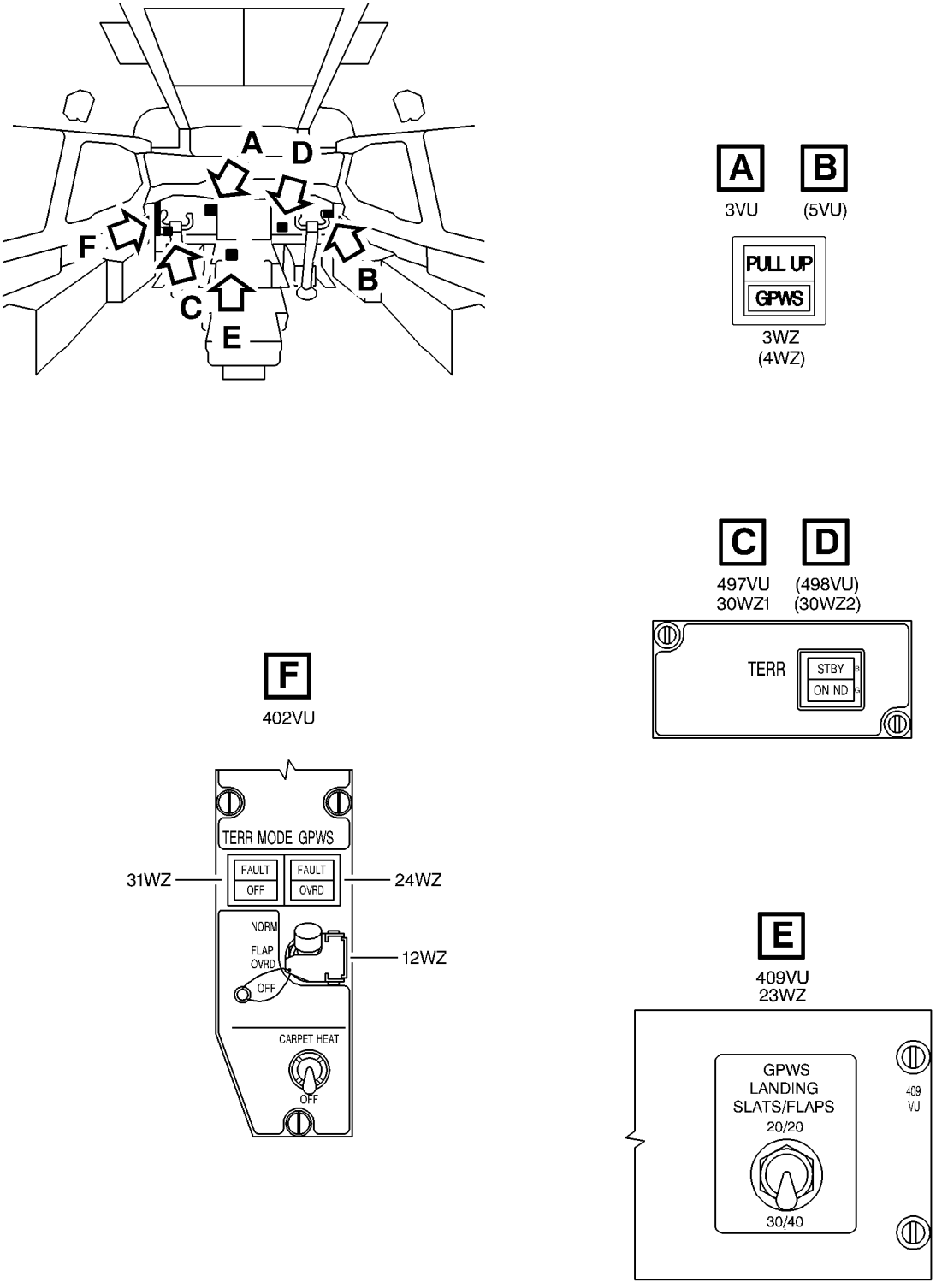
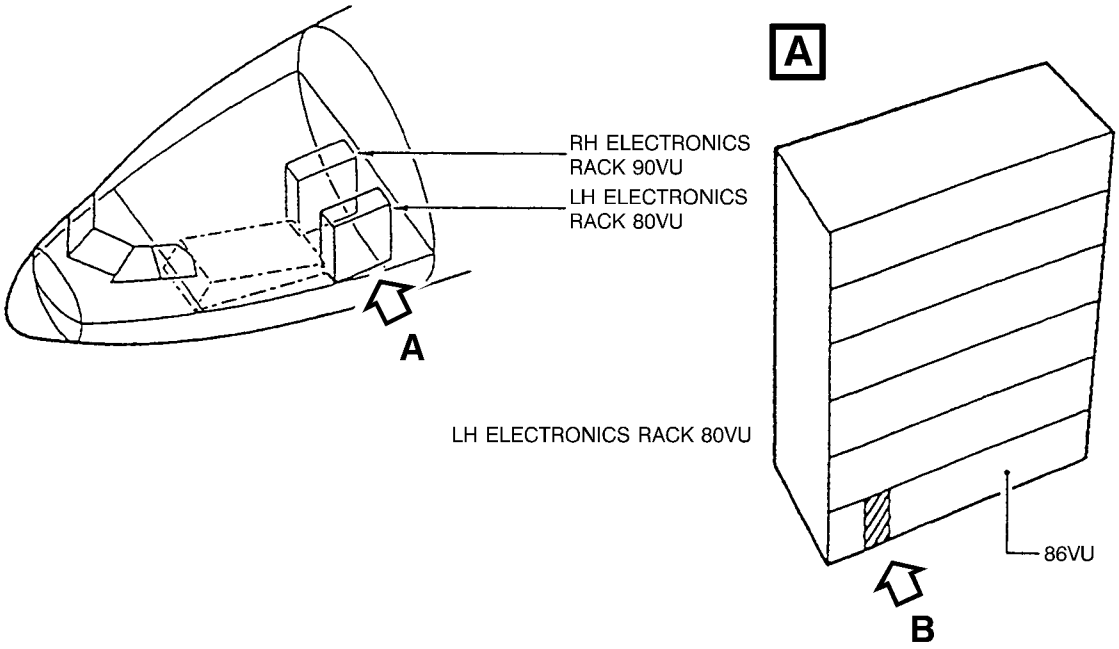
EGPWS - Component Location in Flight Compartment
Figure 003

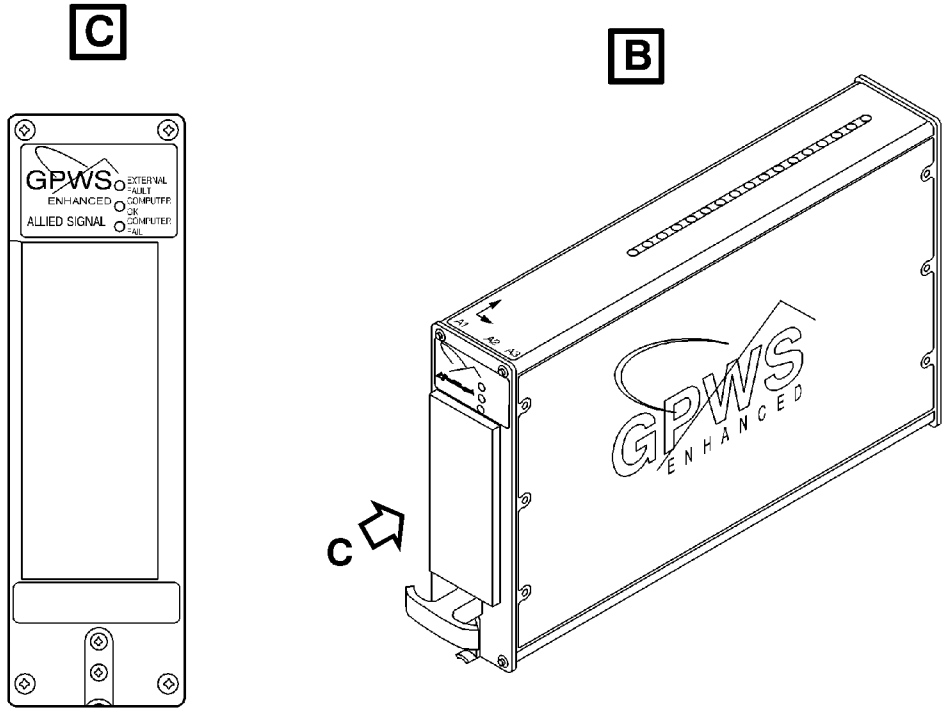


BM5 34 48 00 0 ABC0 00

EGPWS - Component Location in Flight Compartment
Figure 004

R





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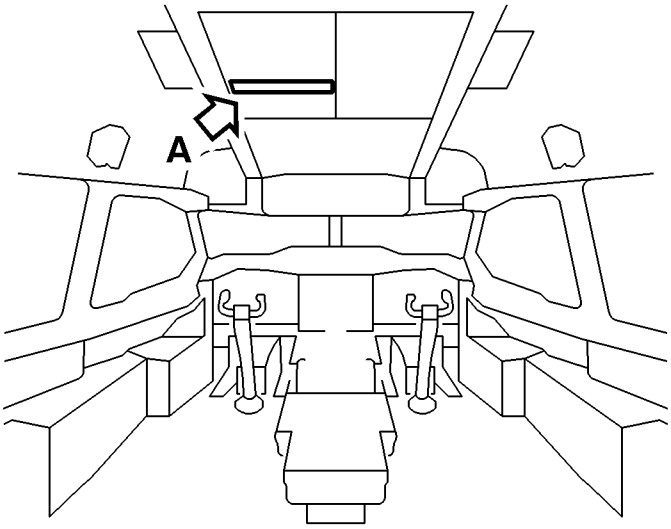
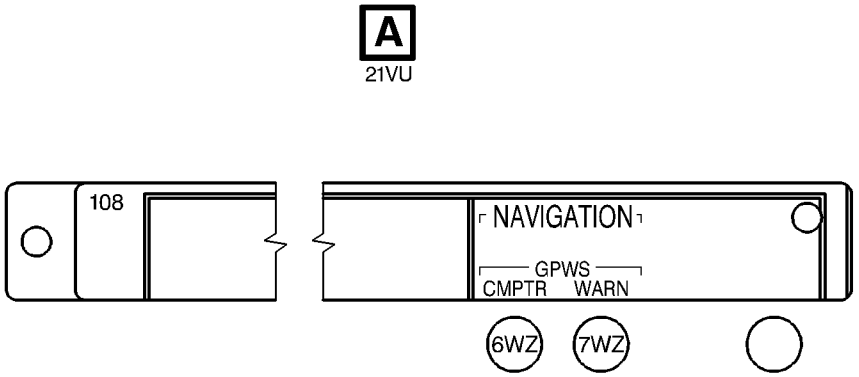
EGPWS - Component Location in Avionics Compartment
Figure 005





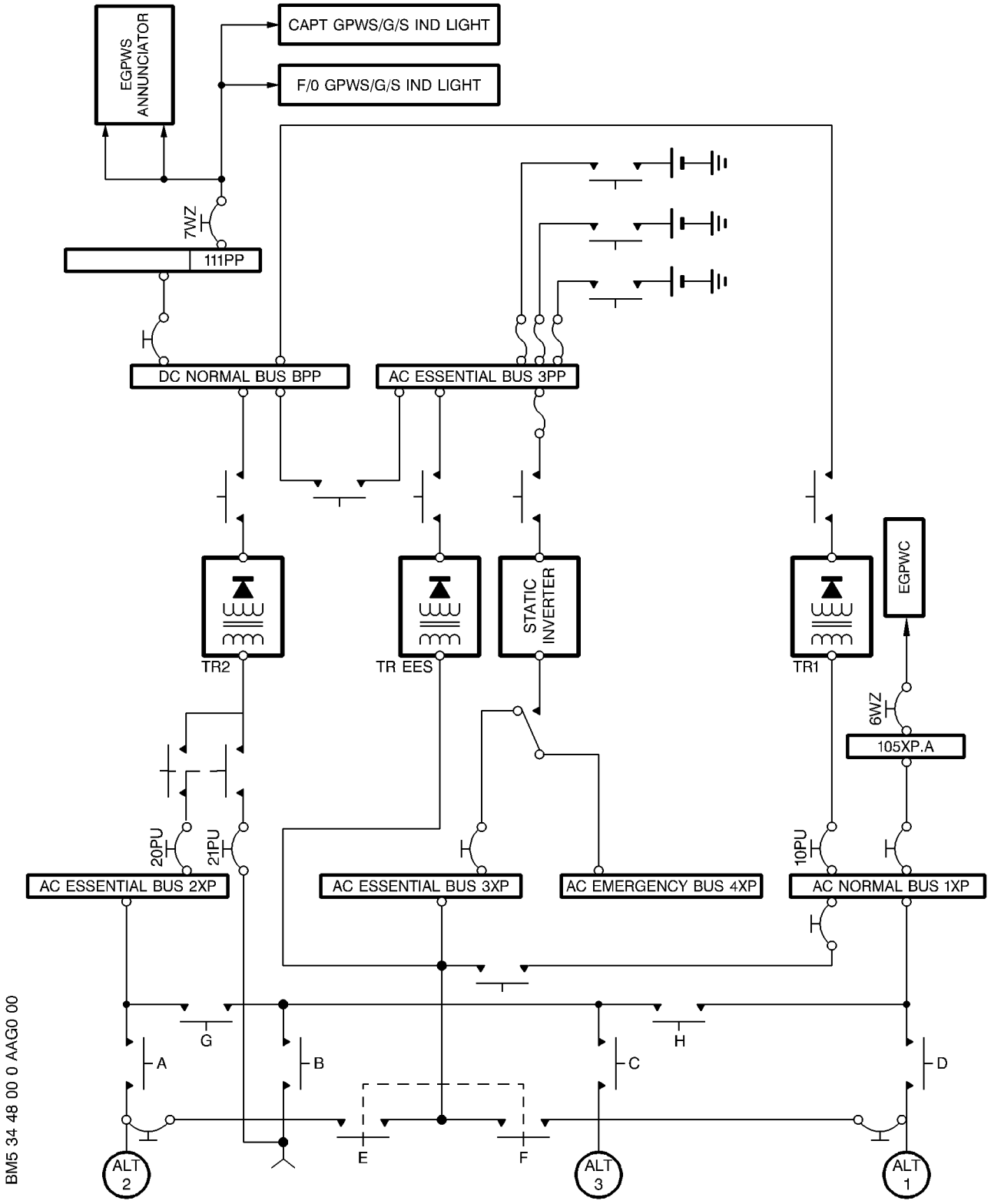
BM5 34 48 00 0 DHM0 00

EGPWS - Circuit Breaker Location
Figure 006

3. Power Supply (Ref. Fig. 007)
Electrical power for the system is derived from the following busbar :
- 28VDC bus 111PP via circuit breaker 7WZ (for GPWS indicator lights and FAULT warning light)
- 115VAC bus 105XPA via circuit breaker 6WZ (for GPWC).

The EGPWC power supply circuits receive 115VAC, 400 Hz, single phase (13.5 W max.) supply from aircraft power and convert this supply to the following DC levels :
±15VDC from linear regulators with current limiting
+5VDC from a compensated switching regulator with current limiting
-30VDC from a voltage doubler, fed by the -15VDC regulated supply.

**ON A/C 101-200,



EGPWS - Power Supply
Figure 007

**ON A/C 101-104,

4. Description (Ref. Fig. 008, 010)
A. The EGPWS monitors data inputs from navigation sensors. This information is used to provide suitable aural and visual warnings to allow the flight crew to avoid inadvertent flight into the terrain.
B. Warnings are generated by the Enhanced Ground Proximity Warning Computer (EGPWC) which is installed in the avionics compartment. Aural warnings are broadcast from the flight compartment loudspeakers.
Visual warnings are provided by GPWS/G/S indicator lights mounted on the Captain's and First Officer's main instrument panels and TAD alerts are displayed on both NDs.

C. A NORM/FLAP OVRD/OFF switch, located on the Captain's switching panel (402VU) allows for abnormal configuration during take-off and approach and also provides a facility to inhibit GPWS mode 1 to 5 functions.

D. A TERR MODE pushbutton switch, located on the Captain's switching panel (402VU), when released (white OFF legend on), inhibits TAD and TCF functions.

E. A GPWS annunciator, also located on the Captain's switching panel (402VU), indicates failure of GPWS mode 1 to 5 functions.

F. CAPT and F/O TERR momentary pushbutton switches which allow the crew to select/deselect terrain display on each ND (when ARC or MAP mode is selected on EFIS control panel).

G. A GPWS/LANDING/SLATS/FLAPS switch, located on panel 409VU, allows flap landing position selection during approach or landing.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

4. Description (Ref. Fig. 009, 011)
A. The EGPWS monitors data inputs from navigation sensors. This information is used to provide suitable aural and visual warnings to allow the flight crew to avoid inadvertent flight into the terrain.

B. Warnings are generated by the Enhanced Ground Proximity Warning Computer (EGPWC) which is installed in the avionics compartment. Aural warnings are broadcast from the flight compartment loudspeakers.
R Visual warnings are provided by PULL UP/GPWS pushbutton switches mounted on the Captain's and First Officer's main instrument panels and TAD

alerts are displayed on both NDs.

C. A NORM/FLAP OVRD/OFF switch, located on the Captain's switching panel (402VU) allows for abnormal configuration during take-off and approach and also provides a facility to inhibit GPWS mode 1 to 5 functions.

D. A TERR MODE pushbutton switch, located on the Captain's switching panel (402VU), when released (white OFF legend on), inhibits TAD and TCF functions.

E. A GPWS annunciator, also located on the Captain's switching panel (402VU), indicates failure of GPWS mode 1 to 5 functions.

F. CAPT and F/O TERR momentary pushbutton switches which allow the crew to select/deselect terrain display on each ND (when ARC or MAP mode is selected on EFIS control panel).

G. A GPWS/LANDING SLATS/FLAPS switch, located on panel 409VU, allows flap landing position selection during approach or landing.

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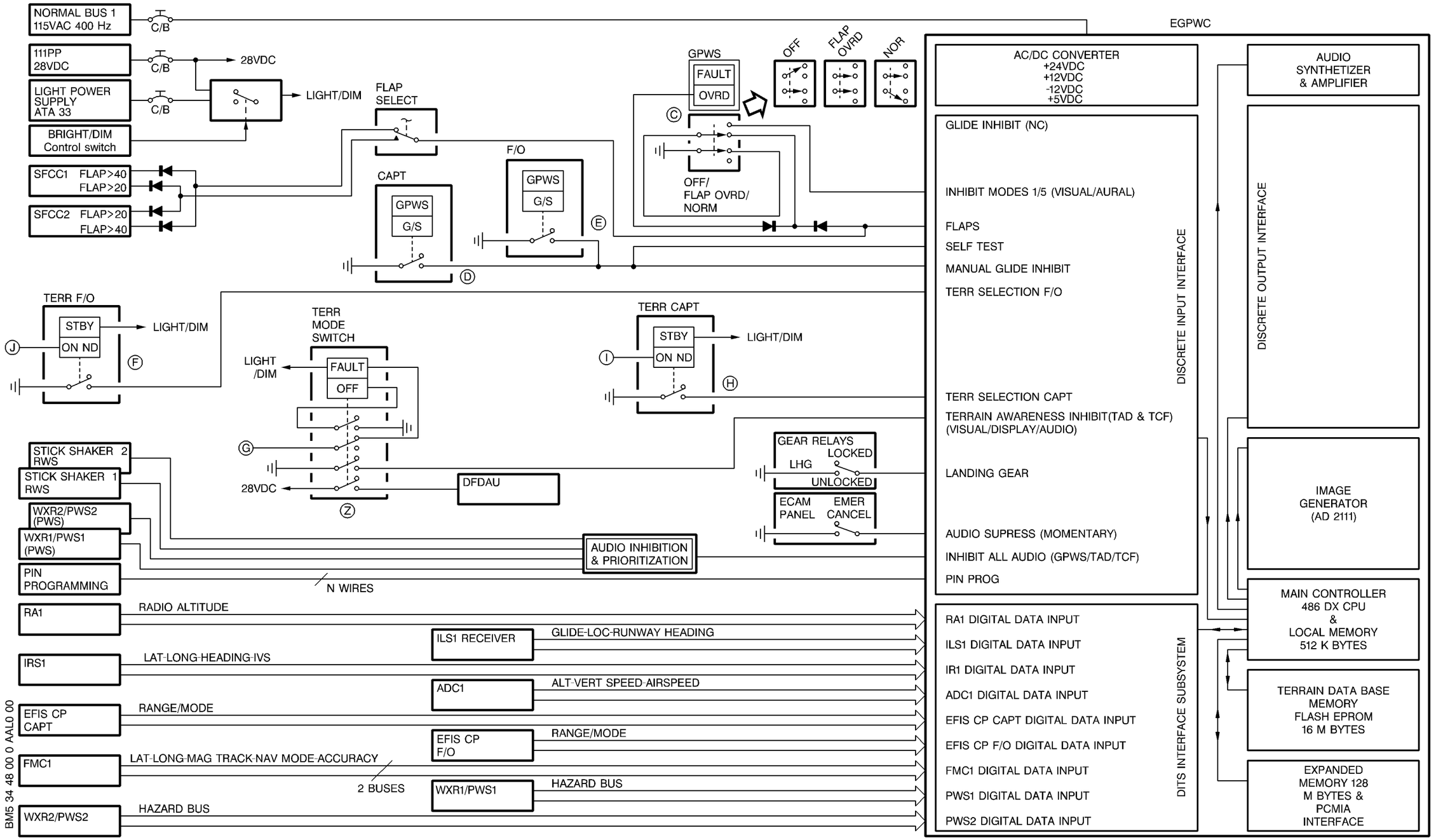
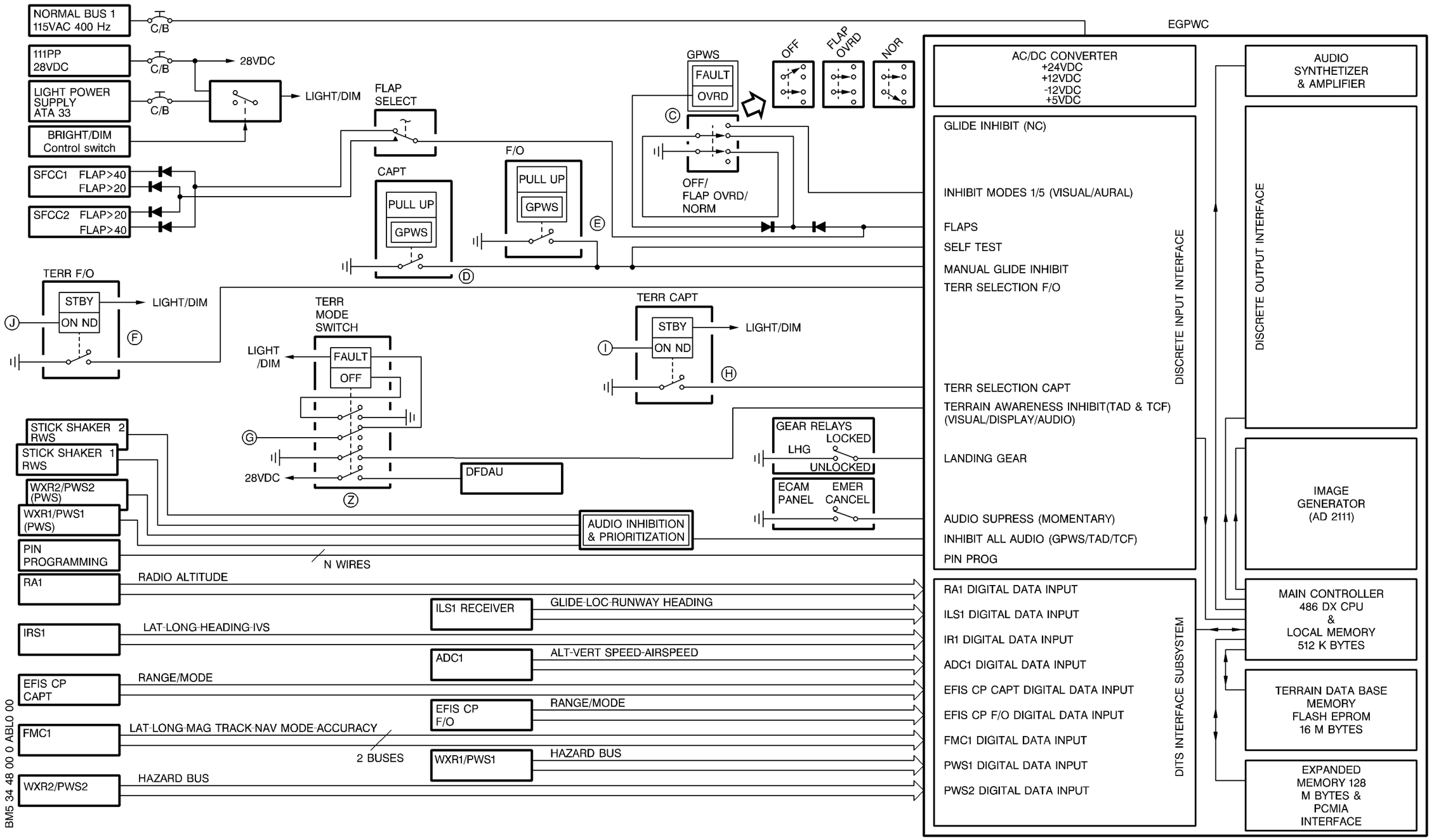
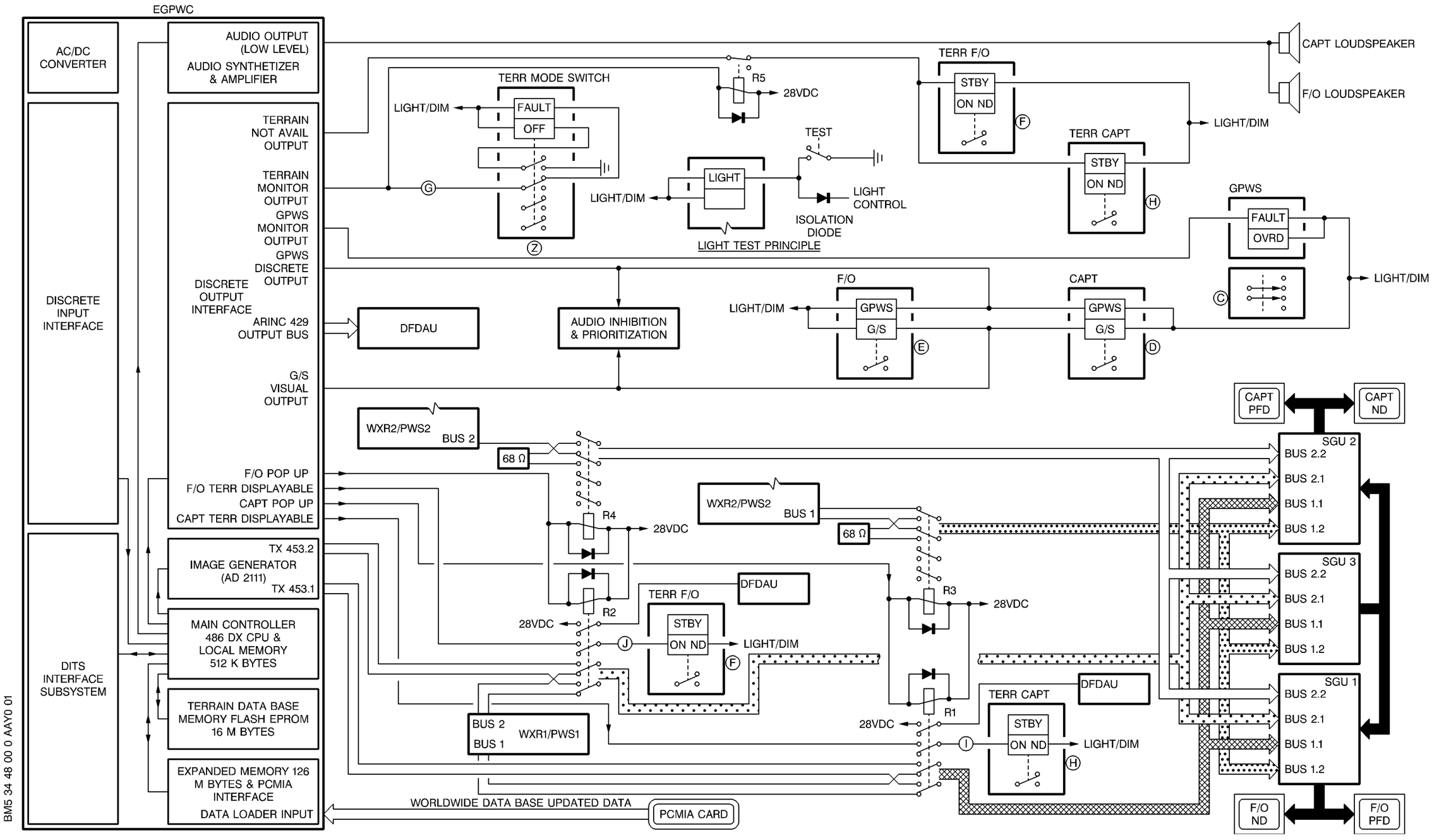


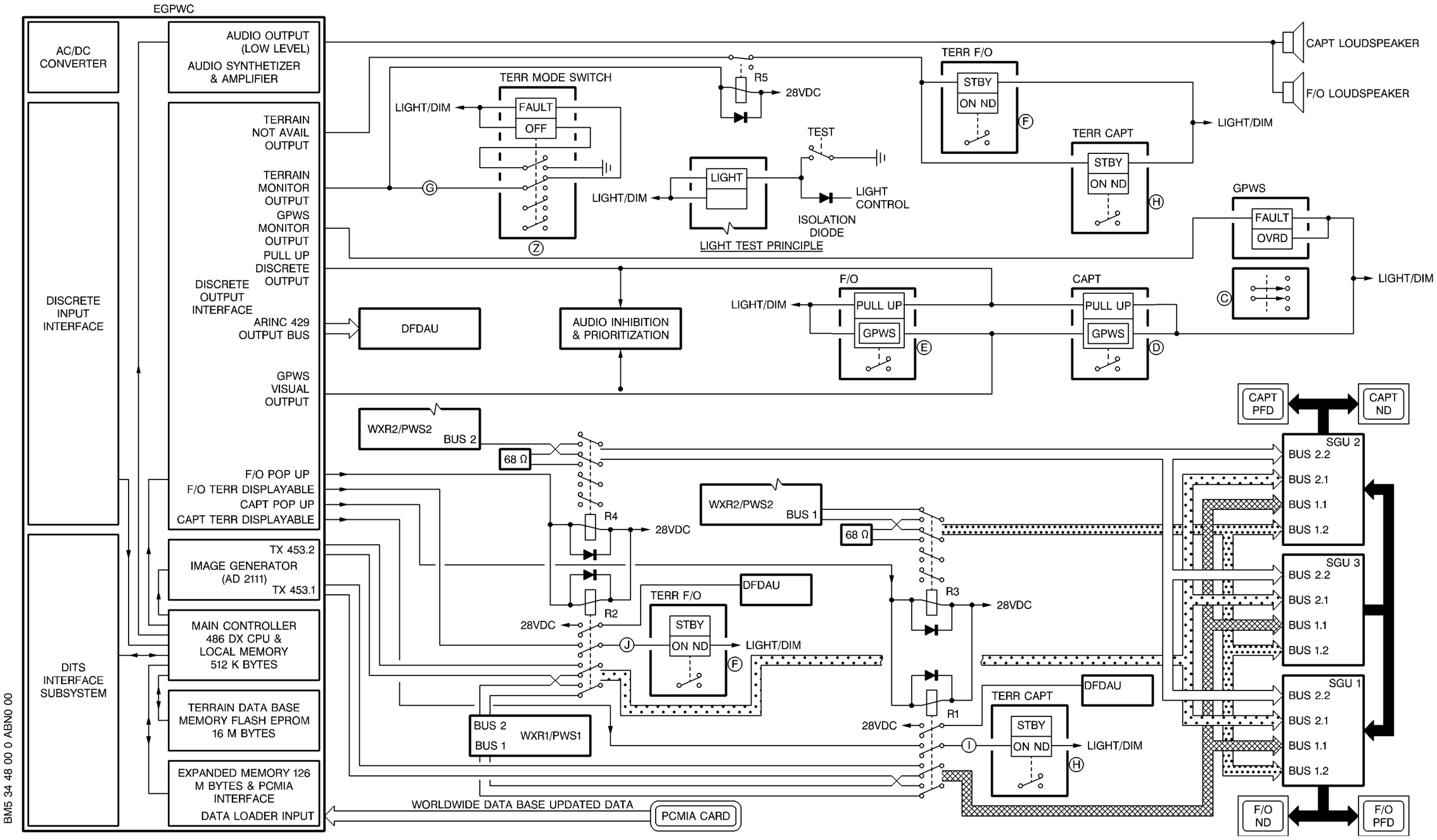
EGPWS - Input
Figure 008



EGPWS - Input
Figure 009



EGPWS - Output
Figure 010



BM5 34 48 00 0 ABN0 00

EGPWS - Output
Figure 011

**ON A/C 101-200,

5. Component Description

A. EGPWC

(1)External Description
(Ref. Fig. 012)
The EGPWC is packaged in a 2 MCU ARINC 600-6 form factor enclosure.
The unit's enclosure is painted with a blue semi-gloss coating, except for the bottom, which is unpainted.
The computer is composed of the following subassemblies :
- rear panel assembly,
- front panel assembly,
- chassis,
- PCMCIA interface,
- front connector.

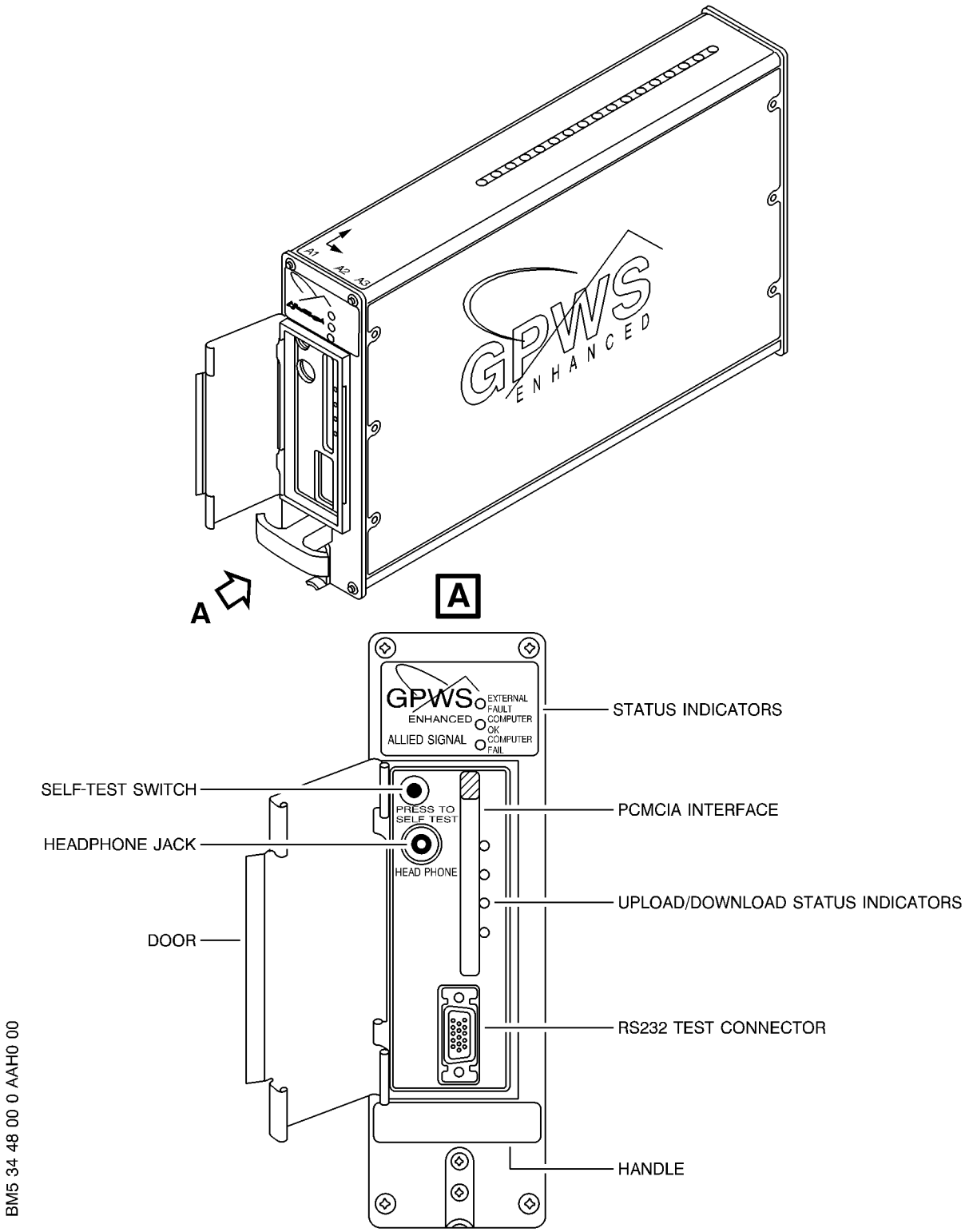
R **ON A/C 101-200,

**ON A/C 101-104,

(a)Rear Panel Assembly
The rear panel assembly contains a 2 MCU ARINC 600-6 form aircraft interface connector. The top and middle shells contain all interface signals. Power interface is in the bottom shell, isolated from interface signals. The index pin coding section separates the two shells and prevents electrical interference.

(b)Front Panel Assembly
The front panel assembly contains idenfification and modification status labels, status LED's, a latched door for access to a self-test switch, a headphone jack, a RS232 test connector (P1), and a PCMCIA interface and status LED's. There is also a handle for ease of carrying and installation/removal, and a hold-down hook for securing at installation.

(c)Chassis
The chassis is welded aluminum, composed of a top and bottom and two sides. It provides slots for Circuit Card Assemblies and space for the front and rear panel assemblies.



EGPWC - Front Face
Figure 012

(d)PCMCIA Interface

The standard Type II PCMCIA interface provided at the front panel allows for both the uploading and downloading of internal EGPWC information. Control of the upload/download process is accomplished by insertion of the PCMCIA card into the front panel access. Four LEDs are provided for PCMCIA interface operation. The PCMCIA card does not remain installed during normal EGPWC operation, and is not intended as an on-line/inflight storage medium.

(e)Front Connector

A 15 pin (double density, D-Sub) test connector is located on the front panel, which provides for connection to either a CRT terminal, or a PC.

This connector provides the following interfaces :

1 Three wire serial interface, compatible with RS232

This port can be used to access internal data from the EGPWC for both bench simulation and aircraft testing. Unit configuration and flight history can also be accessed. This port can also be used to upload software and data bases.

2 ARINC 429/422/423 data loader interface

This port can be used to upload software and data bases.

System power is provided on two of the pins for PCMIA card.

(2)Internal Description

(a)The hardware consists of three main circuit card assemblies :
- the controller card,
- the accessory card,
- the analog acquisition card.

(b)The EGPWC contains the following five processors :
- main processor that runs the EGPWC Application software and the Boot Loader Software,
- DITS handler microcontroller that runs the DITS Handler software,
- imagine generator DPS that runs the image generator software, which is a part of the Application software,
- voice generator DSP that runs the voice generator software, which is part of the Application software,
- analog acquisition microcontroller that runs the Analog Acquisition software.

B. GPWS/G/S Indicator Lights 3WZ, 4WZ

(1)Indicator light 3WZ is located on the Captain's main instrument panel 3VU and indicator light 4WZ is located on the First Officer's main instrument panel 5VU.

(2)Each indicator light consists of a momentary contact, pushbutton switch with an illuminated, split-legend cap. The upper legend GPWS comes on when a ground proximity warning mode 1 to 4 or TAD or TCF is generated by the EGPWC. The lower legend G/S comes on when a glideslope advisory alert (GPWS mode 5) is generated by the EGPWC.

(3)The pushbutton function provides a facility to cancel a glideslope alert (if in progress) or to initiate an EGPWS self-test (aircraft on ground).

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

(a)Rear Panel Assembly
The rear panel assembly contains a 2 MCU ARINC 600-6 form aircraft interface connector. The top and middle shells contain all interface signals. Power interface is in the bottom shell, isolated from interface signals. The index pin coding section separates the two shells and prevents electrical interference.

(b)Front Panel Assembly
The front panel assembly contains idenfification and modification status labels, status LED's, a latched door for access to a self-test switch, a headphone jack, a RS232 test connector (P1), and a PCMCIA interface and status LED's. There is also a handle for ease of carrying and installation/removal, and a hold-down hook for securing at installation.

(c)Chassis

The chassis is welded aluminum, composed of a top and bottom and two sides. It provides slots for Circuit Card Assemblies and space for the front and rear panel assemblies.

(d)PCMCIA Interface

The standard Type II PCMCIA interface provided at the front panel allows for both the uploading and downloading of internal EGPWC information. Control of the upload/download process is accomplished by insertion of the PCMCIA card into the front panel access. Four LEDs are provided for PCMCIA interface operation. The PCMCIA card does not remain installed during normal EGPWC operation, and is not intended as an on-line/inflight storage medium.

(e)Front Connector

A 15 pin (double density, D-Sub) test connector is located on the front panel, which provides for connection to either a CRT terminal, or a PC.

This connector provides the following interfaces :

1 Three wire serial interface, compatible with RS232

This port can be used to access internal data from the EGPWC for both bench simulation and aircraft testing. Unit configuration and flight history can also be accessed. This port can also be used to upload software and data bases.

2 ARINC 429/422/423 data loader interface

This port can be used to upload software and data bases.

System power is provided on two of the pins for PCMIA card.

(2)Internal Description

(a)The hardware consists of three main circuit card assemblies :
- the controller card,
- the accessory card,
- the analog acquisition card.

(b)The EGPWC contains the following five processors :
- main processor that runs the EGPWC Application software and the Boot Loader Software,
- DITS handler microcontroller that runs the DITS Handler software,
- imagine generator DPS that runs the image generator software, which is a part of the Application software,
- voice generator DSP that runs the voice generator software, which is part of the Application software,
- analog acquisition microcontroller that runs the Analog Acquisition software.

R B. PULL UP/GPWS Pushbutton Switches 3WZ, 4WZ

R (1)Pushbutton switch 3WZ is located on the Captain's main instrument
R panel 3VU and pushbutton switch 4WZ is located on the First Officer's main instrument panel 5VU.

(2)Each indicator light consists of a momentary contact, pushbutton switch with an illuminated, split-legend cap. The red upper legend PULL UP comes on when an aural alert containing PULL UP (mode 1 to 2 or TAD) is generated by the EGPWC. All other EGPWS alerts will illuminate the amber lower legend GPWS.

(3)The pushbutton function provides a facility to cancel a glideslope alert (if in progress) or to initiate an EGPWS self-test (aircraft on ground).

**ON A/C 101-200,

C. NORM/FLAP OVRD/OFF Switch 12WZ

(1)The GPWS/NORM/FLAP OVRD/OFF switch is located on the Captain's switching panel 402VU.

(2)The switch is a 3-position toggle switch guarded in the NORM position to prevent inadvertent selection of FLAP OVRD or OFF.

(3)When NORM is selected, normal operation of mode 1 to 5 of the EGPWC is assumed whereby the flaps down input (flaps ≥ 40 deg.) is provided by Slat/Flap Control Computers 1 and 2 (SFCC 1 and 2).
When FLAP OVRD is selected, the switch disconnects the SFCCs input and applies a flap down discrete to the EGPWC, irrespective of flap surface position. When OFF is selected, all EGPWS modes 1 to 5 are inhibited.

**ON A/C 101-200,

(Ref. Fig. 013)

**ON A/C 101-200,

D. GPWS Annunciator 24WZ
(1)The GPWS annunciator is located on the Captain's switching panel 402VU, directly above the NORM/FLAP OVRD/OFF switch.
(2)The FAULT legend comes on amber when the EGPWC detects a fault which affects GPWS modes 1 to 5. When the FAULT legend comes on amber, all ground proximity warnings modes 1 to 5 are inhibited.
(3)The FAULT legend does not come on for a fault of the ILS1 receiver, in order to have the modes 1 to 4 available.
(4)The OVRD legend comes on when the NORM/FLAP OVRD/OFF switch is in the FLAP OVRD position.

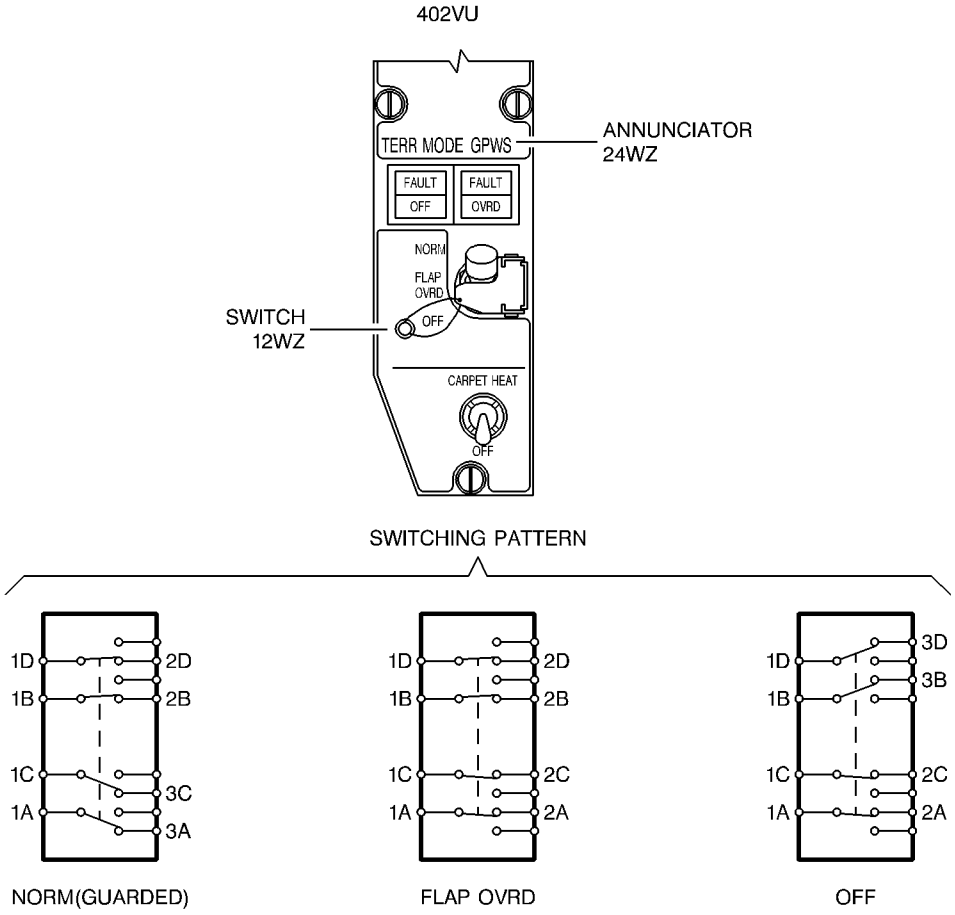
**ON A/C 101-200,

E. GPWS/LANDING/SLATS/FLAPS Switch 23WZ
(1)The GPWS/LANDING/SLATS/FLAPS switch is located on panel 409VU beside the First Officer FMC CDU.
It allows the selection between two flap landing positions during approach or landing :
- 20/20 degrees
- 30/40 degrees
(2)The switch enables the pilot to send to the EGPWC the flap position 40 degrees information through a discrete signal, whatever the signal sent by the SFCCs.

**ON A/C 101-200,

(Ref. Fig. 014)

**ON A/C 101-200,



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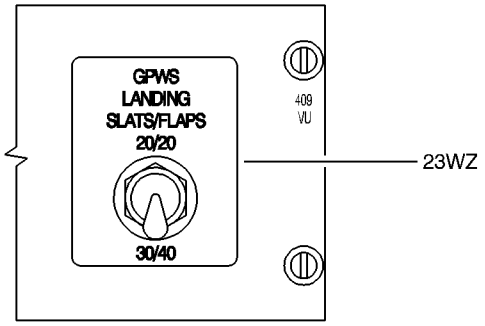
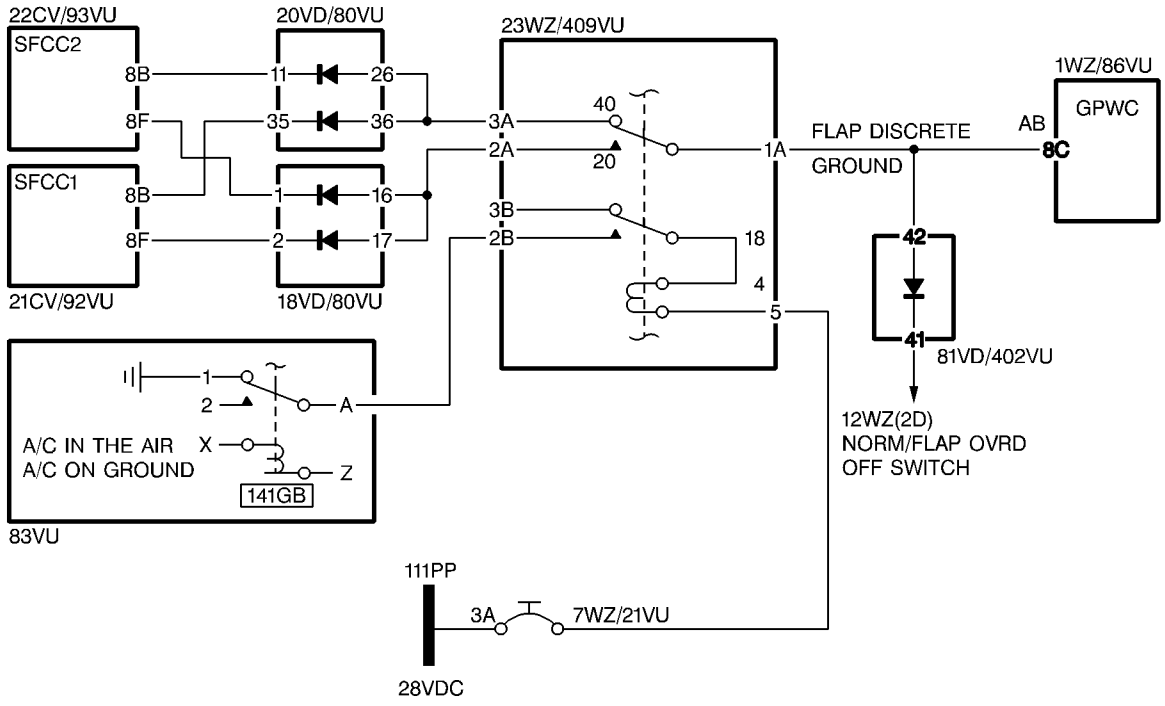
EGPWS - NORM/FLAP OVRD/OFF Switch
Figure 013





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GPWS/LANDING/SLATS/FLAPS Switch (23WZ)
Figure 014

F. CAPT and F/O TERR Pushbutton Switches 30WZ1 and 30WZ2 (Ref. Fig. 015)
These pushbutton switches allow the crew to select or deselect terrain display on ND's only if the EFIS control panel is in ARC or MAP mode.
The ON ND legends indicate that terrain data is displayed on ND's (following manual or automatic pop up selection).

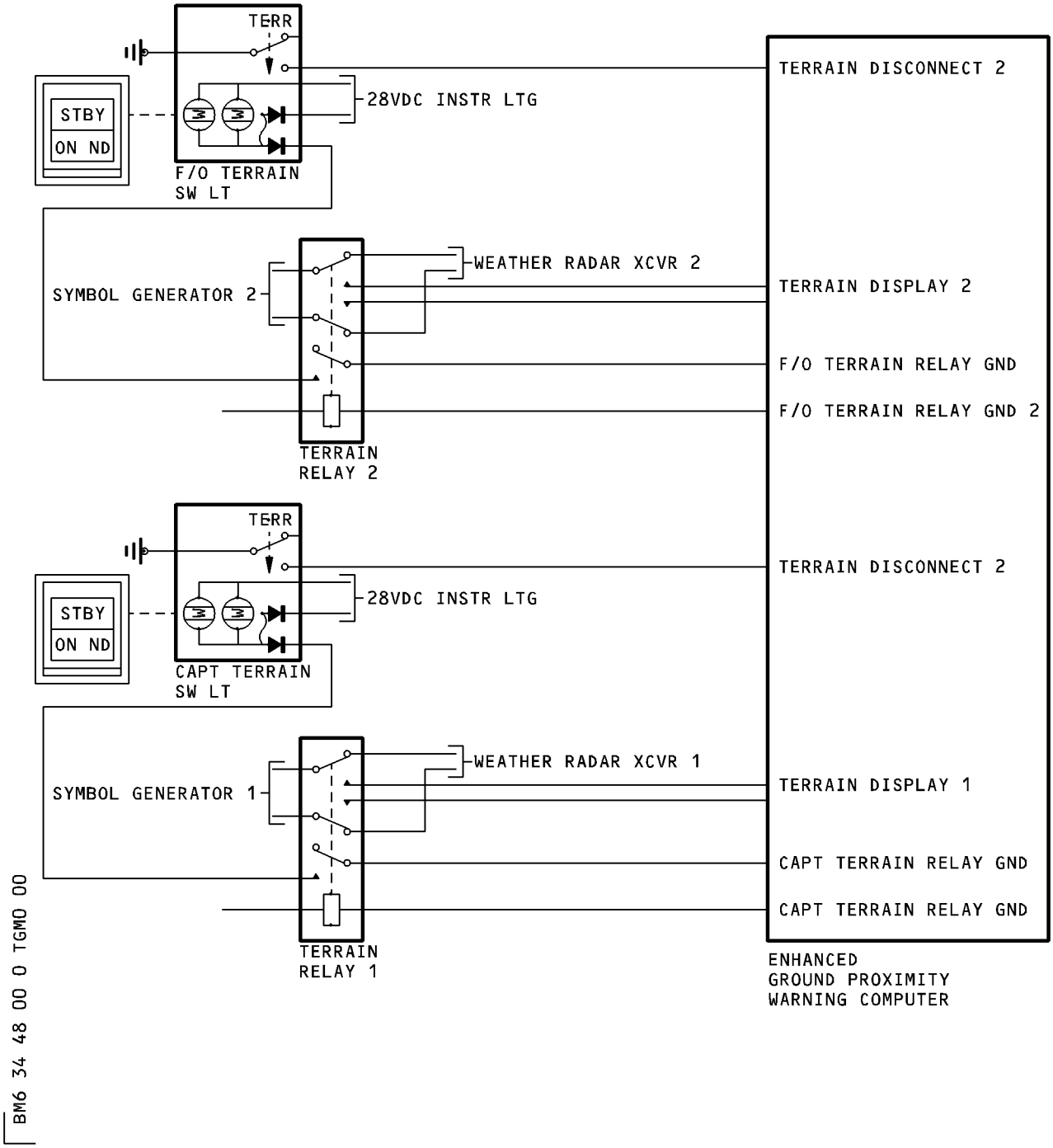
**ON A/C 101-200,

**ON A/C 101-200,

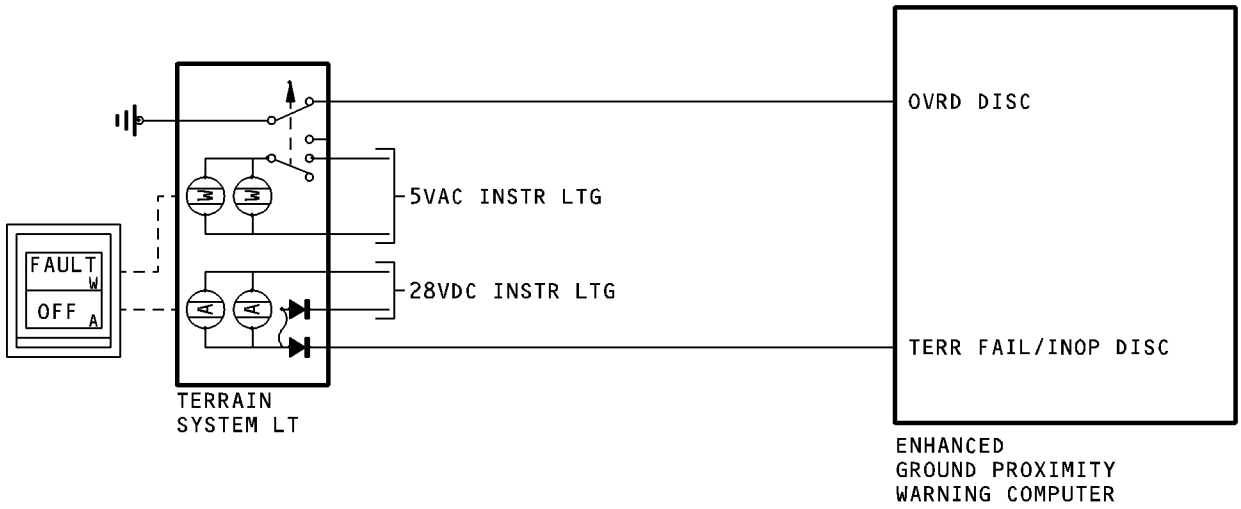
G. TERR MODE Pushbutton Switch 31WZ
(1)When the TERR MODE pushbutton switch is pressed, the TAD and TFC functions are inhibited (visual display and audio inhibition).
(2)The TERR MODE pushbutton switch provides a fault warning indicating that a failure of TAD and/or TCF functions has been detected by the EGPWC.

**ON A/C 101-200,

(Ref. Fig. 016)



TERR Pushbutton Switches
Figure 015



BM6 34 48 00 0 TJM0 00

TERR MODE Pushbutton Switch
Figure 016

**ON A/C 101-104,

6. Operation

A. General

(1)Warning modes
The serial digital data and discrete data inputs are interfaced and used in different combinations to monitor aircraft situation awareness with respect to the terrain. The following functions are implemented within the EGPWS :
Mode 1 - Excessive rate of descent
Mode 2 - Excessive closure rate with terrain
Mode 3 - Descent after takeoff and minimum terrain clearance
Mode 4 - Unsafe terrain clearance
Mode 5 - Descent below glide slope
Terrain Awareness and Display (TAD)
Terrain Clearance Floor (TCF)

(2)Aural alert messages
Each mode computes and compares aircraft behaviour with a corresponding alert envelope. If the alert envelope is penetrated, visual and aural alerts are generated. The aural message is broadcast through the flight compartment loudspeakers.
The messages are as follows :

MODE	AURAL ALERTS	VISUAL ALERTS
1	SINK RATE	GPWS
1	PULL UP	GPWS
2	TERRAIN	GPWS
2	TERRAIN TERRAIN	GPWS
2	PULL UP	GPWS
3	DON'T SINK	GPWS
4	TOO LOW TERRAIN	GPWS
4	TOO LOW GEAR	GPWS
4	TOO LOW FLAPS	GPWS
5	GLIDE SLOPE	G/S
TAD	TERRAIN AHEAD	GPWS
TAD	TERRAIN AHEAD PULL UP	GPWS
TCF	TOO LOW TERRAIN	GPWS

(3)Inhibitions
Alerts may be cancelled by :

(a)Pressing the GPWS/G/S indicator lights on the main instrument panel for mode 5 (glide slope) visual and aural alert. This inhibition is temporary and the mode will be automatically reactivated for a new

envelope penetration.

(b)Setting the **NORM/FLAP OVRD/OFF** switch to **OFF** which inhibits **EGPWS** modes 1 to 5 (aural and visual).
Enhanced functions (**TAD** and **TCF**) are not inhibited.

(c)Pressing the **TERR MODE** pushbutton switch on the Captain switching panel 402VU for inhibition of **TAD** and **TCF** functions (visual and aural alerts).

(4)Faults which prevent normal **EGPWC** operation are stored in the **BITE** memory and may be announced through loudspeaker during self test sequence (Ref. Para. 7.).

B. Detailed Operation - Modes 1 through 5
This section describes the five warning modes of the EGPWC and describes the operation of each of the modes.

(1)Mode 1 - Excessive rate of descent

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

6. Operation

A. General

(1)Warning modes
The serial digital data and discrete data inputs are interfaced and used in different combinations to monitor aircraft situation awareness with respect to the terrain. The following functions are implemented within the EGPWS :
Mode 1 - Excessive rate of descent
Mode 2 - Excessive closure rate with terrain
Mode 3 - Descent after takeoff and minimum terrain clearance
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Mode 5 - Descent below glide slope
Terrain Awareness and Display (TAD)
Terrain Clearance Floor (TCF)

(2)Aural alert messages
Each mode computes and compares aircraft behaviour with a corresponding alert envelope. If the alert envelope is penetrated, visual and aural alerts are generated. The aural message is broadcast through the flight compartment loudspeakers.
The messages are as follows :

MODE	AURAL ALERTS	VISUAL ALERTS
1	SINK RATE	GPWS
1	PULL UP	GPWS
2	TERRAIN	GPWS
2	TERRAIN TERRAIN	GPWS
2	PULL UP	GPWS
3	DON'T SINK	GPWS
4	TOO LOW TERRAIN	GPWS
4	TOO LOW GEAR	GPWS
4	TOO LOW FLAPS	GPWS
5	GLIDE SLOPE	G/S
TAD	TERRAIN AHEAD	GPWS
TAD	TERRAIN AHEAD PULL UP	GPWS
TAD	OBSTACLE AHEAD	GPWS

TAD	OBSTACLE AHEAD PULL UP	GPWS
TCF	TOO LOW TERRAIN	GPWS

(3)Inhibitions
Alerts may be cancelled by:

R (a)Pressing the **PULL UP/GPWS** pushbutton switches on the main instrument panel for mode 5 (glide slope) visual and aural alerts. This inhibition is temporary and the mode will be automatically reactivated for a new envelope penetration.

(b)Setting the **NORM/FLAP OVRD/OFF** switch to **OFF** which inhibits **EGPWS** modes 1 to 5 (aural and visual).
Enhanced functions (**TAD** and **TCF**) are not inhibited.

(c)Pressing the **TERR MODE** pushbutton switch on the Captain switching panel 402VU for inhibition of **TAD** and **TCF** functions (visual and aural alerts).

(4)Faults which prevent normal **EGPWC** operation are stored in the **BITE** memory and may be announced through loudspeaker during self test sequence (Ref. Para. 7.).

B. Detailed Operation - Modes 1 through 5
This section describes the five warning modes of the EGPWC and describes the operation of each of the modes.

(1)Mode 1 - Excessive rate of descent

**ON A/C 101-200,

(Ref. Fig. 017)

**ON A/C 101-200,

(a)Mode 1 provides the pilot with an alert/warning for high descent rates into terrain. The pilot also receives a timely alert for rapidly building sink rates near the runway when landing. The figure shows the outer and inner boundaries whose penetration trigger the alert/warnings.

(b)The outer boundary is a straight line which has an equation of :

H warn (ft.) = - 572 ft. - 0,6035 X Altitude rate.

NOTE : The descent rate is considered negative during the descent. The formulas provide design goals only.

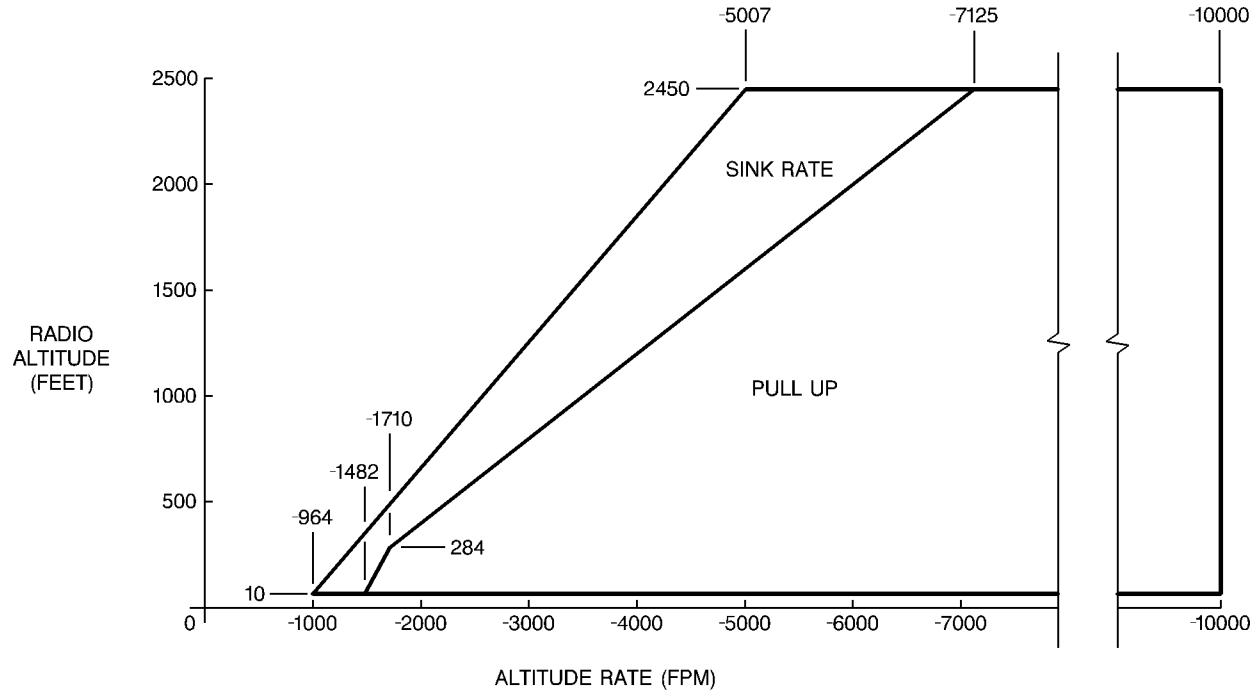
(c)The outer warning boundary is biased to the right as a function of Glideslope Deviation above (Fly Down) the beam in order to prevent unwanted warnings while re-positioning from above the beam.

(d)The penetration of this outer boundary will activate the GPWS legends and produce the voice warning SINK RATE repeated twice, then will remain silent unless the Excessive Descent Rate condition degrades by approximately 20 per cent.

(e)Further penetration of the first boundary will reach the inner boundary where the voice warning will change from SINK RATE to PULL UP. This inner boundary is composed of two straight lines. The equation which describes the lower line is :

H warn (ft) = - 1620 ft. - 1.1133 X Altitude rate.

The equation which describes the upper line is :



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EGPWS - Excessive Rate of Descent
Figure 017

H warn (ft) = - 400 ft. - 0.400 X Altitude rate.

(f)Both boundaries are cut off at the top by a radio altitude of 2450 ft. The lower is cut off at 10 ft. A delay equivalent to 0.8 seconds is included in the upper function to minimize the warnings caused by the momentary boundary penetration.

(g)Both boundaries can be biased to the right at certain airports through Envelope Modulation to minimize nuisance warnings.

(2)Mode 2 - Excessive closure rate with terrain

**ON A/C 101-200,

(Ref. Fig. 018)

**ON A/C 101-200,

Post SB 34-2205 For A/C 101-200,

Post SB 34-2207 For A/C 101-200,

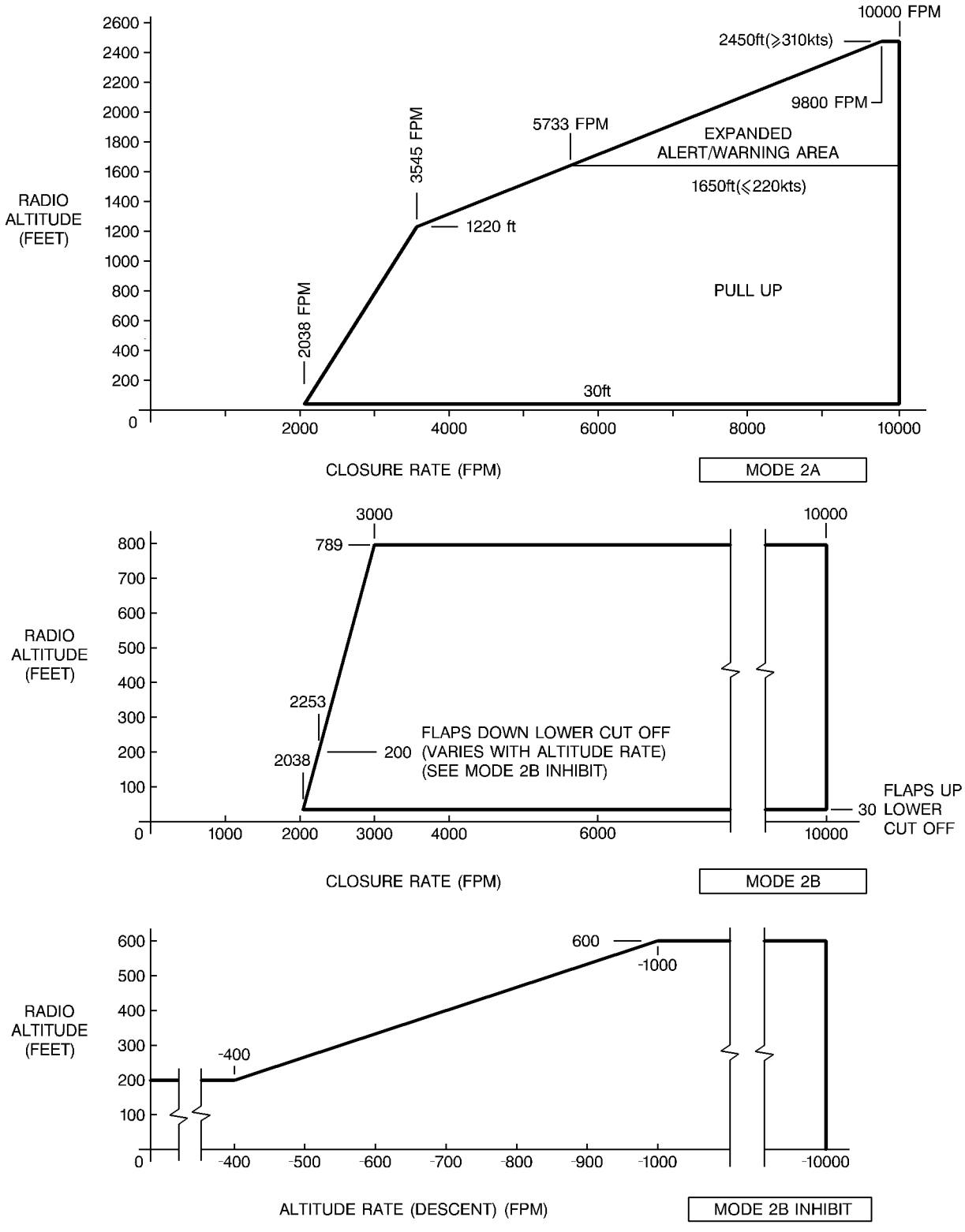
R (Ref. Fig. 019)

**ON A/C 101-104,

(a)Mode 2 provides a warning based on the radio altitude between the aircraft and the ground and on how rapidly the radio altitude decreases.
The barometric altitude of the aircraft is not important for the initiation of this warning.

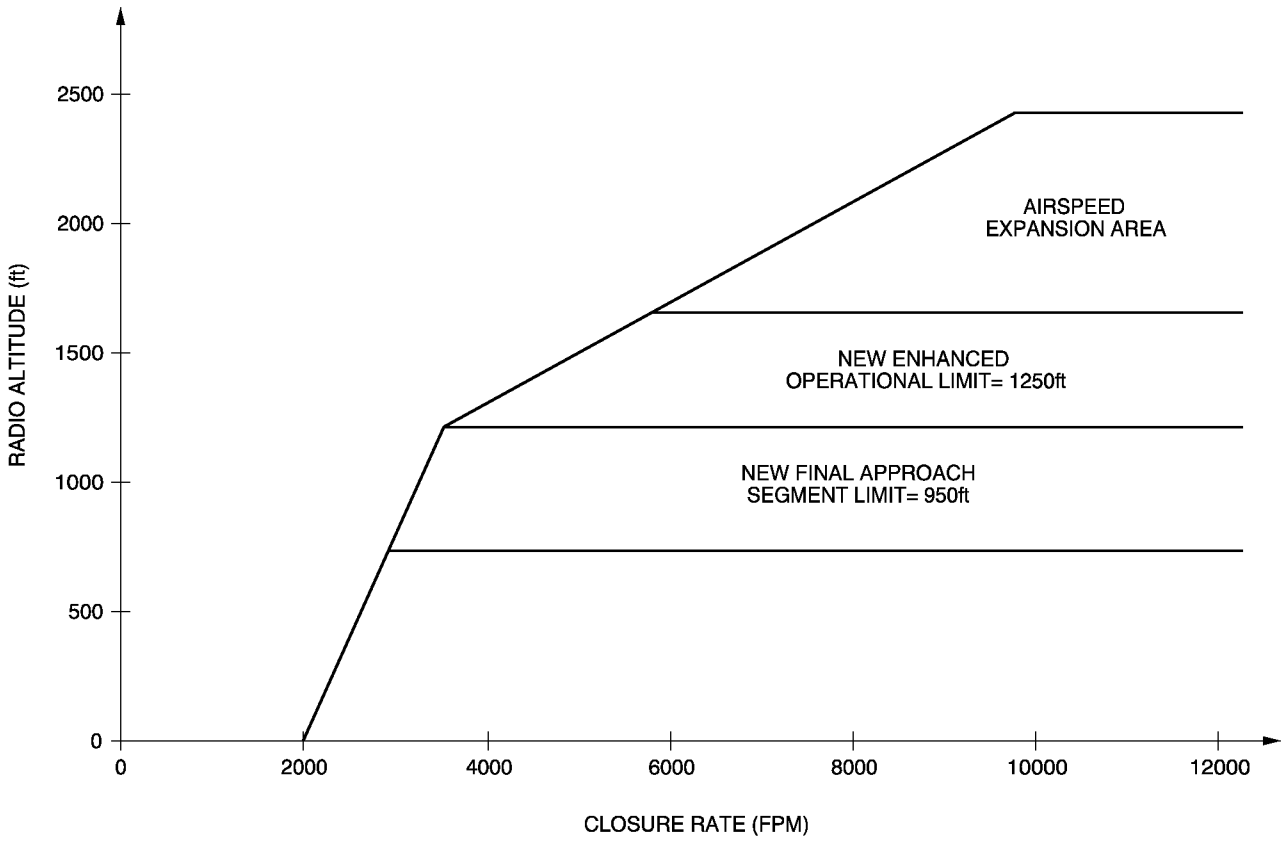
(b)The altitude rate is complemented in the filter to provide lead information. The increase of the altitude descent rate will tend to speed up the warning occurrence. The reduction of the altitude descent rate of the initiation of a climb will tend to delay the warning occurence or reduce the time the warning is on.

(c)This mode has two areas of application that are generally referred to as mode 2A and mode 2B. Mode 2A is applied when the landing flaps



BM5 34 48 00 0 DBM0 01

EGPWS - Terrain Closure Rate
Figure 018



MODE 2 WITH GEOMETRIC ALTITUDE

BM5 34 48 00 0 DTM0 01

R EGPWS - Mode 2 with Geometric Altitude
Figure 019

are not down and the aircraft is not in the glide slope beam. Mode 2B requires that the landing flaps be down or that the aircraft be in the glide slope beam within +/- 2 dots of deviation during an ILS approach. The figure shows the warning boundary for mode 2A (landing flaps up). The closure rate is the computed change in the radio altitude between the aircraft and the ground. It is considered positive when the altitude decreases.
The lower sloped line has an equation of :

H warn (ft.) = - 1579 ft. + 0.7895 X Closure Rate (FPM).

The upper sloped line has an equation of :

H warn (ft) = 522 ft + 0.1968 X closure rate (FPM).

(d) The normal upper limit of the boundary is horizontal at 1650 ft. radio altitude due to a computed maximum closure rate limit of 5733 FPM. As the airspeed increases from 220 Kts up to 310 Kts, the maximum rate limit is linearly increased to 9800 FPM. This allows the upper boundary to also linearly increase up to 2450 ft.
The upper boundary is limited at certain airports to reduce the warning sensitivity and minimize the nuisance warnings.

(e) Upon penetration of the boundary, either on the slope or from the top, the GPWS legends come on and the voice message is TERRAIN TERRAIN. If the boundary penetration lasts beyond these two TERRAIN messages, approximately 1 second, then the warning switches to PULL UP repeated continuously until the boundary is departed. When the mode 2A envelope is exited, after having been violated for more than 3 seconds, an Altitude Gain feature is automatically activated. First the altitude at this instant is sampled and stored. The GPWS legends remain on and the voice message is TERRAIN. After three hundred feet of altitude are gained from the stored value, or 45 seconds have elapsed from the point where the PULL-UP envelope was exited, the GPWS legends and voice stop. If another boundary penetration occurs during this altitude gain time, and it lasts long enough to restart the PULL UP warning plus 3 seconds, then the whole process begins again whith a new reference altitude for the 300 ft. after boundary separation.
In this manner the aircraft is directed up and over the terrain to a safer altitude.

(f) Lowering the flaps to the landing position automatically switches the GPWS to Mode 2B. The static boundary for Mode 2B is the same as the Mode 2A boundary except the upper limit which has been lowered to 789 ft. at a maximum closure rate of 3000 FPM. The lower part of the Mode 2B boundary is controlled as a function of radio altitude and altitude rate when flaps are in full landing configuration.

(g) Mode 2B is also selected when the aircraft is performing an ILS approach and the glide slope and localizer deviations are less than +/- 2 dots. However, the warning envelope is slightly different from

the flaps down case in that the lower boundary is controlled only as a function of radio altitude, having a constant lower cutoff of 30 ft. above ground level. When the flaps are selected to landing configuration in the ILS beams, the lower boundary is activated, (mode 2B inhibit).

(h)When the envelope boundary conditions for Mode 2B are violated, the GPWS legends come on, and the voice message is repeated until the boundary is exited. If the gear or the flap are up, then the message will be **TERRAIN TERRAIN** followed by **PULL UP** if the condition persists. If both gear and flaps are in the landing configuration, the message will be **TERRAIN.**

(3)Mode 3 - Insufficient climb performance after takeoff

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2205 For A/C 101-200,

Post SB 34-2207 For A/C 101-200,

(a)Mode 2 provides a warning based on the radio altitude between the aircraft and the ground and on how rapidly the radio altitude decreases.
The barometric altitude of the aircraft is not important for the initiation of this warning.

(b)The altitude rate is complemented in the filter to provide lead information. The increase of the altitude descent rate will tend to speed up the warning occurrence. The reduction of the altitude descent rate of the initiation of a climb will tend to delay the warning occurence or reduce the time the warning is on.

(c)This mode has two areas of application that are generally referred to as mode 2A and mode 2B. Mode 2A is applied when the landing flaps are not down and the aircraft is not in the glide slope beam. Mode 2B requires that the landing flaps be down or that the aircraft be in the glide slope beam within +/- 2 dots of deviation during an ILS approach. The figure shows the warning boundary for mode 2A (landing flaps up). The closure rate is the computed change in the radio altitude between the aircraft and the ground. It is considered positive when the altitude decreases.
The lower sloped line has an equation of :

H warn (ft.) = - 1579 ft. + 0.7895 X Closure Rate (FPM).

The upper sloped line has an equation of :

H warn (ft) = 522 ft + 0.1968 X closure rate (FPM).

(d) The normal upper limit of the boundary is horizontal at 1650 ft. radio altitude due to a computed maximum closure rate limit of 5733 FPM. As the airspeed increases from 220 Kts up to 310 Kts, the maximum rate limit is linearly increased to 9800 FPM. This allows the upper boundary to also linearly increase up to 2450 ft.
The upper boundary is limited at certain airports to reduce the warning sensitivity and minimize the nuisance warnings.

(e) Upon penetration of the boundary, either on the slope or from the top, the GPWS legends come on and the voice message is TERRAIN TERRAIN.
If the boundary penetration lasts beyond these two TERRAIN messages, approximately 1 second, then the warning switches to PULL UP repeated continuously until the boundary is departed. When the mode 2A envelope is exited, after having been violated for more than 3 seconds, an Altitude Gain feature is automatically activated. First the altitude at this instant is sampled and stored. The GPWS legends remain on and the voice message is TERRAIN. After three hundred feet of altitude are gained from the stored value, or 45 seconds have elapsed from the point where the PULL-UP envelope was exited, the GPWS legends and voice stop.
If another boundary penetration occurs during this altitude gain time, and it lasts long enough to restart the PULL UP warning plus 3 seconds, then the whole process begins again with a new reference altitude for the 300 ft. after boundary separation.
In this manner the aircraft is directed up and over the terrain to a safer altitude.

(f) Lowering the flaps to the landing position automatically switches the GPWS to Mode 2B. The static boundary for Mode 2B is the same as the Mode 2A boundary except the upper limit which has been lowered to
R 950 ft. at a maximum closure rate of 3000 FPM. The lower part of the Mode 2B boundary is controlled as a function of radio altitude and altitude rate when flaps are in full landing configuration.

(g) Mode 2B is also selected when the aircraft is performing an ILS approach and the glide slope and localizer deviations are less than +/- 2 dots. However, the warning envelope is slightly different from the flaps down case in that the lower boundary is controlled only as a function of radio altitude, having a constant lower cutoff of 30 ft. above ground level. When the flaps are selected to landing configuration in the ILS beams, the lower boundary is activated, (mode 2B inhibit).

(h) When the envelope boundary conditions for Mode 2B are violated, the GPWS legends come on, and the voice message is repeated until the boundary is exited. If the gear or the flap are up, then the message will be TERRAIN TERRAIN followed by PULL UP if the condition persists. If both gear and flaps are in the landing configuration, the message

will be TERRAIN.

(j)When Geometric Altitude is activated and the following conditions are available :
- Enhanced functions are valid
- Terrain database quality is good
- Geometric Altitude is valid
- Terrain awareness function is in high integrity.

Current Mode 2 alert envelopes are modified in order to limit spurious alert.
The new envelope limits the top of the Mode 2 curve to 1250 ft. RA.
The Mode 2 envelope is also reduced to the existing mode 2 B limit of
R 950 ft. whenever the aircraft is within 10NM of the runway.
(Ref. Fig. 019)

(3)Mode 3 - Insufficient climb performance after takeoff

**ON A/C 101-200,

(Ref. Fig. 020)

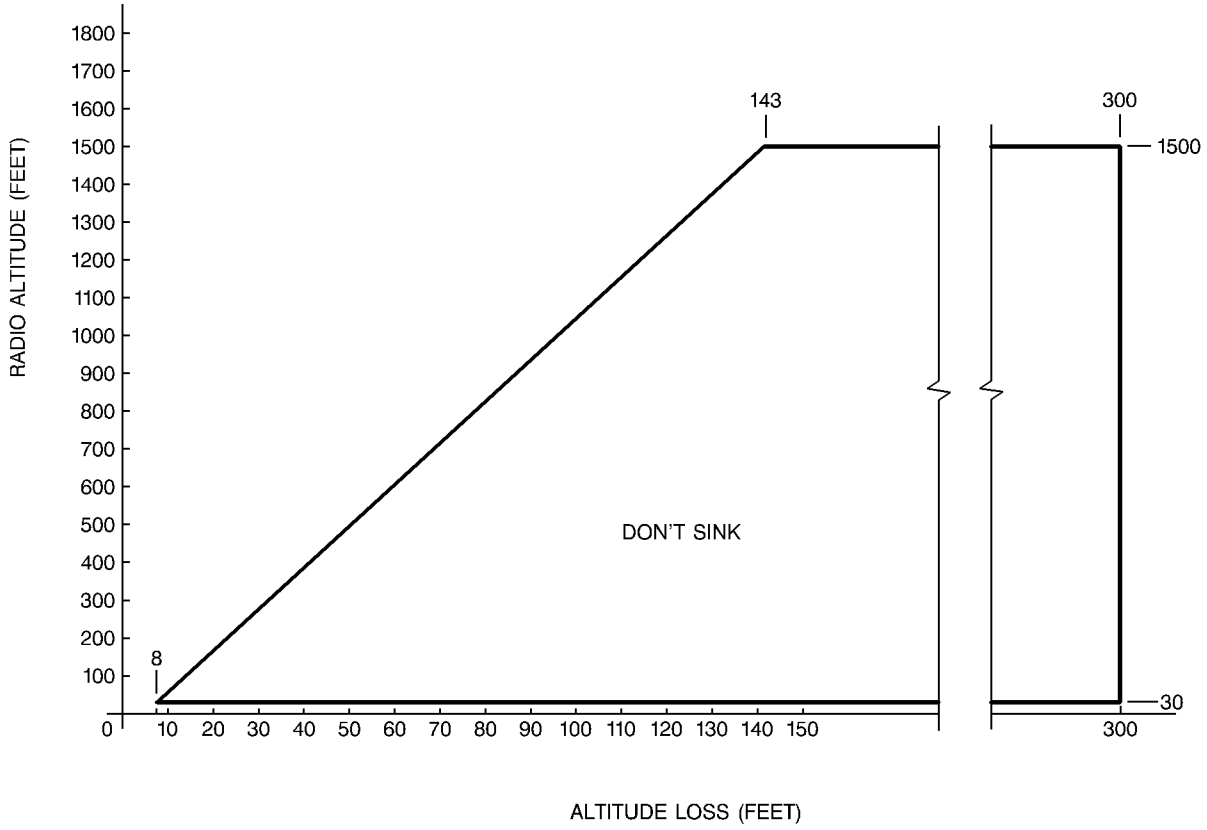
**ON A/C 101-104,

(a)Mode 3 provides a warning for excessive altitude loss after takeoff. Mode 3 is based primarily on radio altitude, altitude (IR inertial altitude, internally computed inertial altitude, or barometric altitude), and altitude rate (IVS, internally computed inertial altitude rate, or barometric altitude rate).

(b)Penetration of the Mode 3 alert/boundary will result in the message "DON'T SINK" and is based on Altitude loss and Radio Altitude. This alert/warning is only provided during take-off when the aircraft looses a predetermined amount of altitude.
The sloped portion of the static warning envelope depicted is defined by the following equation :

ALTITUDE LOSS (FT) = 5.4 + 0.092 (RADIO ALTITUDE (FT))

(c)Inertially compensated air data signals are used when possible. IVS is used when valid data is available and barometric altitude rate is used only when valid IVS is not available and the internal computed inertial data is not valid. The Mode 3 warning envelopes are inhibited close to the ground.



BM5 34 48 00 0 DCM0 03

EGPWS - Descent After Takeoff
Figure 020

(d)The descent required for a warning varies as a function of flight profile and time. Once a descent begins during the takeoff phase of flight, as determined by the polarity of the altitude rate signal and takeoff/approach mode logic, the EGPWC will store the existing value of altitude. Subsequent samples of altitude, altitude rate, and radio altitude are examined for warning conditions. The original stored value of altitude indicating where the descent began is retained until the aircraft ascends above the stored altitude value. When the polarity of the altitude rate signal indicates ascent rather than descent, the warning is cut off to indicate recovery is being initiated. A subsequent return to descent prior to regaining the altitude lost enables the warning. The altitude loss required to resume the message and legend activation is based on the initially stored altitude value. In this manner, the possibility of stair stepping down without Mode 3 warning indication is eliminated.

(e)Mode 3 is biased or desensitized under certain conditions. This is accomplished by sampling Radio Altitude and Altitude at takeoff or go-around, and combining these signals to establish the field elevation (or ground elevation at the point of go-around). Subsequent altitude information is then compared to this value to determine the altitude gained since takeoff or go-around.

(f)A delay equivalent to 0.8 second is added to the warning output to prevent the possibility of nuisance warnings caused by static pressure disturbances during gear retraction.

(4)Mode 4 - Unsafe terrain clearance
(Ref. Fig. 021, 023)

(a)Mode 4 generates three types of voice warnings based on the radio altitude, computed airspeed, and aircraft configuration, commonly referred to as modes 4A, 4B and 4C. The standard upper boundary is at 500 ft. radio altitude. If the aircraft penetrates this boundary with the landing gear still up and the flaps not in landing configuration (20° or 40°), the voice message will be **TOO LOW GEAR** corresponding to Mode 4A. Above 190 Kts airspeed, the upper boundary increases linearly with airspeed to a maximum of 1000 ft. radio altitude at 250 Kts or more. Penetrating this boundary produces a repetitive **TOO LOW TERRAIN** message. Other maximums are used at certain airports to minimize the nuisance warnings.
The mode 4 maximum altitude is lowered from 1000 to 800 ft. of radio altitude when an overflight is detected. An overflight can be detected by sensing the sudden change in radio altitude. The 800 ft. limit is maintained for 60 seconds after an overflight to ensure that a nuisance warning is not issued.

(b)When the landing gear or flaps are lowered, the upper boundary decreases to 245 ft corresponding to Mode 4B. To maintain the same airspeed expansion function up to 1000 ft. nominal at 250 Kts, the lower level corner is at 159 Kts.
Penetration below 159 Kts results in **TOO LOW GEAR** messages with gear up or **TOO LOW FLAPS** message with gear down and flaps not in landing configuration, while above 159 Kts the message is **TOO LOW TERRAIN.**

(c)The equation for the sloped portion of the warning curve is :

H warn (ft.) = - 1083 ft. + 8.333 X Computed Airspeed (Kts)

(d)The basic Audio De-Clutter feature will apply a ratched function to the Mode 4 voice warning which is similar to the Mode 3 ratcheting voice message. Once the message is given, the envelope is biased down by 20 per cent and further warnings are held off until this additional 20 per cent Radio Altitude is lost. The lamp is not affected and will remain on until the Radio Altitude becomes greater then the curves of the illustration. (Ref. Fig. 021)
Mode 4 also provides a warning based on minimum Radio Altitude clearance during takeoff. This warning is similar to the Mode 4A warning that is active during the cruise and approach phases of flight, only in this case, the Minimum Terrain Clearance is a function of the Radio Altitude of the aircraft. The sloped portion of the envelope boundary is described by the equation :
MIN TERRAIN CLEARANCE (FT) = 0.75 (RADIO ALTITUDE (FT))
Mode 4C is based on a minimum terrain clearance, or floor, that increases with Radio Altitude during takeoff. A value equal to 75 per cent of the current Radio Altitude is accumulated in a long term filter that is only allowed to increase in value. If the Radio Altitude should later decrease, the filter will store its maximum attained

value. Further decrease of Radio Altitude below the stored filter value with Gear of Flaps up will result in the warning "Too Low Terrain" (or equivalent).
A simplified example will illustrate this operation. First assume the Radio Altitude increases rapidly from zero feet to 400 ft..
The filter will begin charging to 75 per cent of 400 ft., or 300 ft..
In 20 seconds, the filter will have charged up to approximately 220 ft.. Now if the Radio Altitude decreases so that 75 per cent of this value results in something less than 220 ft. (i.e., approximately 295 ft. or less), the filter remains at a value of 220 ft.. Further Reductions in Radio Altitude below 220 ft. will result in the "TOO LOW TERRAIN" warning.
This warning is provided to prevent inadvertent controlled flight into the ground during takeoff climb into terrain that produces insufficient closure rate for a Mode 2 warning. After takeoff, and mode change over from Takeoff to Cruise or Approach, then Mode 4A and 4B provide this protection.
The basic Audio De-Clutter feature will apply a ratchet function to the Mode 4C voice warning which is equivalent to the ratcheting voice message described above. Once the message is given, the envelope is biased down by 20 per cent and further warnings are held off until this additional 20 per cent Radio Altitude is lost. The lamp is not affected and will remain on until the terrain clearance problem is rectified.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2205 For A/C 101-200,

Post SB 34-2207 For A/C 101-200,

(a)Mode 3 provides a warning for excessive altitude loss after takeoff. Mode 3 is based primarily on radio altitude, altitude (IR inertial altitude, internally computed inertial altitude, or barometric altitude), and altitude rate (IVS, internally computed inertial altitude rate, or barometric altitude rate).

(b)Penetration of the Mode 3 alert/boundary will result in the message "DON'T SINK" and is based on Altitude loss and Radio Altitude. This alert/warning is only provided during take-off when the aircraft looses a predetermined amount of altitude.
The sloped portion of the static warning envelope depicted is defined by the following equation :

ALTITUDE LOSS (FT) = 5.4 + 0.092 (RADIO ALTITUDE (FT))

(c)Inertially compensated air data signals are used when possible. IVS is used when valid data is available and barometric altitude rate is used only when valid IVS is not available and the internal computed inertial data is not valid. The Mode 3 warning envelopes are inhibited close to the ground.

(d)The descent required for a warning varies as a function of flight profile and time. Once a descent begins during the takeoff phase of flight, as determined by the polarity of the altitude rate signal and takeoff/approach mode logic, the EGPWC will store the existing value of altitude. Subsequent samples of altitude, altitude rate, and radio altitude are examined for warning conditions. The original stored value of altitude indicating where the descent began is retained until the aircraft ascends above the stored altitude value. When the polarity of the altitude rate signal indicates ascent rather than descent, the warning is cut off to indicate recovery is being initiated. A subsequent return to descent prior to regaining the altitude lost enables the warning. The altitude loss required to resume the message and legend activation is based on the initially stored altitude value. In this manner, the possibility of stair stepping down without Mode 3 warning indication is eliminated.

(e)Mode 3 is biased or desensitized under certain conditions. This is accomplished by sampling Radio Altitude and Altitude at takeoff or go-around, and combining these signals to establish the field elevation (or ground elevation at the point of go-around). Subsequent altitude information is then compared to this value to determine the altitude gained since takeoff or go-around.

(f)A delay equivalent to 0.8 second is added to the warning output to prevent the possibility of nuisance warnings caused by static pressure disturbances during gear retraction.

(4)Mode 4 - Unsafe terrain clearance
(Ref. Fig. 022, 023)

(a)Mode 4 generates three types of voice warnings based on the radio altitude, computed airspeed, and aircraft configuration, commonly referred to as modes 4A, 4B and 4C. The standard upper boundary is at 500 ft. radio altitude. If the aircraft penetrates this boundary with the landing gear still up and the flaps not in landing configuration (20° or 40°), the voice message will be **TOO LOW GEAR** corresponding to Mode 4A. Above 190 Kts airspeed, the upper boundary increases linearly with airspeed to a maximum of 1000 ft. of radio altitude at 250 Kts or more. Penetrating this boundary produces a repetitive **TOO LOW TERRAIN** message. Other maximums are used at certain airports to minimize the nuisance warnings.
The mode 4 maximum altitude is lowered from 1000 to 800 ft. of radio altitude when an overflight is detected. An overflight can be detected by sensing the sudden change in radio altitude. The 800 ft. limit is maintained for 60 seconds after an overflight to ensure that a nuisance warning is not issued.

(b)When the landing gear or flaps are lowered, the upper boundary decreases to 245 ft. corresponding to Mode 4B.To maintain the same airspeed expansion function up to 1000 ft. nominal at 250 Kts, the lower level corner is at 159 Kts.
Penetration below 159 Kts results in **TOO LOW GEAR** message with gear up or **TOO LOW FLAPS** message with gear down and flaps not in landing configuration, while above 159 Kts the message is **TOO LOW TERRAIN** with flaps up and remains **TOO LOW GEAR** with flaps down.
All modes 4A/4B are disabled when aircraft is in full landing configuration.

(c)The equation for the sloped portion of the warning curve is :

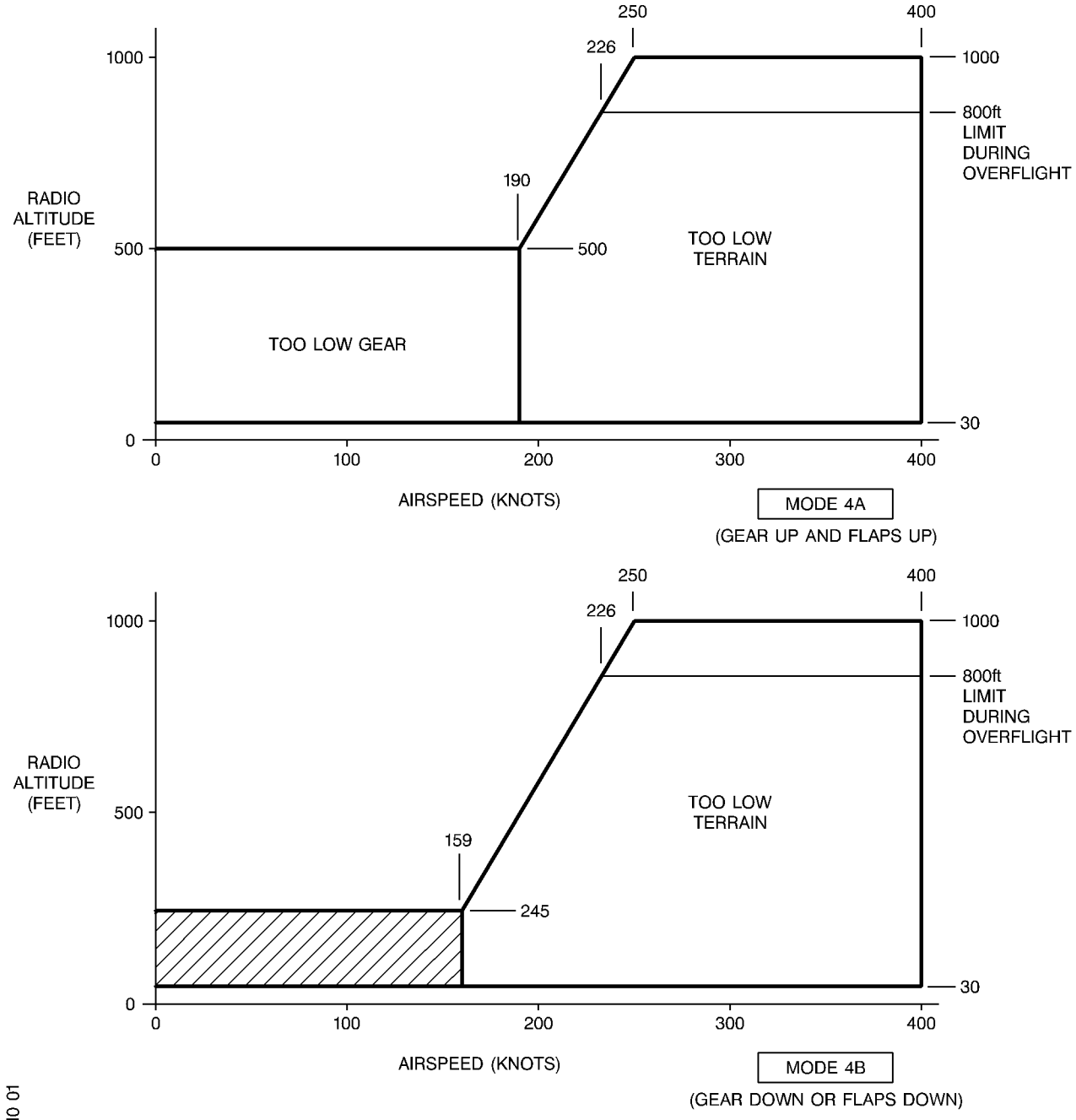
H warn (ft.) = - 1083 ft. + 8.333 X Computed Airspeed (Kts)

(d)The basic Audio De-Clutter feature will apply a ratched function to the Mode 4 voice warning which is similar to the Mode 3 ratcheting voice message. Once the message is given, the envelope is biased down by 20 per cent and further warnings are held off until this additional 20 per cent Radio Altitude is lost. The lamp is not affected and will remain on until the Radio Altitude becomes greater then the curves of the illustration. (Ref. Fig. 023)
Mode 4 also provides a warning based on minimum Radio Altitude clearance during takeoff. This warning is similar to the Mode 4A warning that is active during the cruise and approach phases of flight, only in this case, the Minimum Terrain Clearance is a function of the Radio Altitude of the aircraft. The sloped portion of the envelope boundary is described by the equation :
MIN TERRAIN CLEARANCE (FT) = 0.75 (RADIO ALTITUDE (FT))
Mode 4C is based on a minimum terrain clearance, or floor, that increases with Radio Altitude during takeoff. A value equal to 75 per

cent of the current Radio Altitude is accumulated in a long term filter that is only allowed to increase in value. If the Radio Altitude should later decrease, the filter will store its maximum attained value. Further decrease of Radio Altitude below the stored filter value with Gear of Flaps up will result in the warning "Too Low Terrain" (or equivalent).
A simplified example will illustrate this operation. First assume the Radio Altitude increases rapidly from zero feet to 400 ft..
The filter will begin charging to 75 per cent of 400 ft., or 300 ft.. In 20 seconds, the filter will have charged up to approximately 220 ft.. Now if the Radio Altitude decreases so that 75 per cent of this value results in something less than 220 ft. (i.e., approximately 295 ft. or less), the filter remains at a value of 220 ft.. Further Reductions in Radio Altitude below 220 ft. will result in the "TOO LOW TERRAIN" warning.
This warning is provided to prevent inadvertent controlled flight into the ground during takeoff climb into terrain that produces insufficient closure rate for a Mode 2 warning. After takeoff, and mode change over from Takeoff to Cruise or Approach, then Mode 4A and 4B provide this protection.
The basic Audio De-Clutter feature will apply a ratchet function to the Mode 4C voice warning which is equivalent to the ratcheting voice message described above. Once the message is given, the envelope is biased down by 20 per cent and further warnings are held off until this additional 20 per cent Radio Altitude is lost. The lamp is not affected and will remain on until the terrain clearance problem is rectified.

(e)The Mode 4A maximum limit is reduced to 500 ft. when one of the following conditions is true :
- Terrain Clearance Floor function is operational (in track valid Radio Altitude and FMC in High Accuracy)
- Terrain Awareness function is operational in that all needed inputs are valid and the FMC is in High Accuracy. The Terrain Awareness function must be using Geometric Altitude where VFOM and HIL are valid, no RAIM failure is detected, and the geometric altitude VFOM is less than 200 feet (or less than the look ahead algorithm's allowed terrain clearance value which is a function of distance to the runway).

(f)The Mode 4B maximum limit is reduced to 245 ft. when one of the following conditions is true :
- Flaps are down or flaps override selected
- Terrain Clearance Floor function is operational (in track valid Radio Altitude and FMC in High Accuracy)
- Terrain Awareness function is operational in that all needed inputs are valid and the FMC is in High Accuracy. The Terrain Awareness function must be using Geometric Altitude where VFOM and HIL are valid, no RAIM failure is detected, and the geometric altitude VFOM is less than 200 feet (or less than the look ahead algorithm's allowed terrain clearance value which is a function of distance to the runway).



EGPWS - Unsafe Terrain Clearance - Sheet 1/2
Figure 021

**ON A/C 101-104,

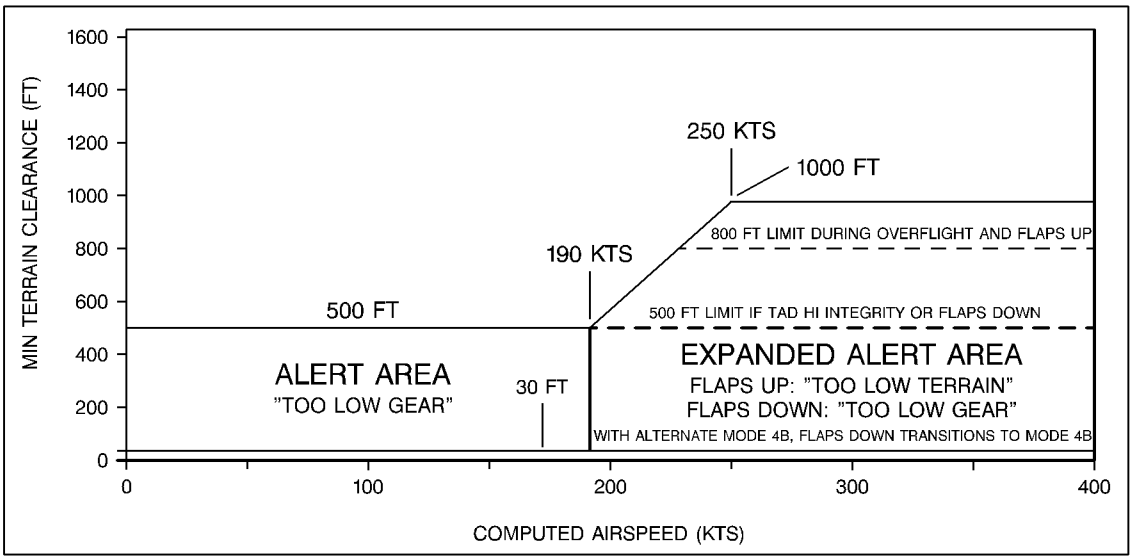
**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

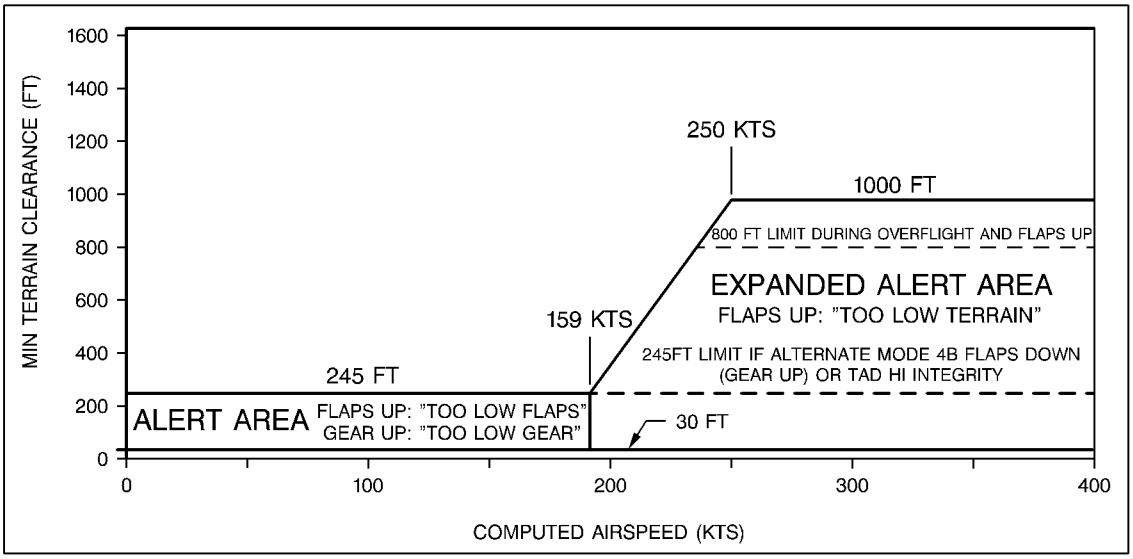
Post SB 34-2205 For A/C 101-200,

Post SB 34-2207 For A/C 101-200,

**ON A/C 101-200,



MODE 4A



MODE 4B

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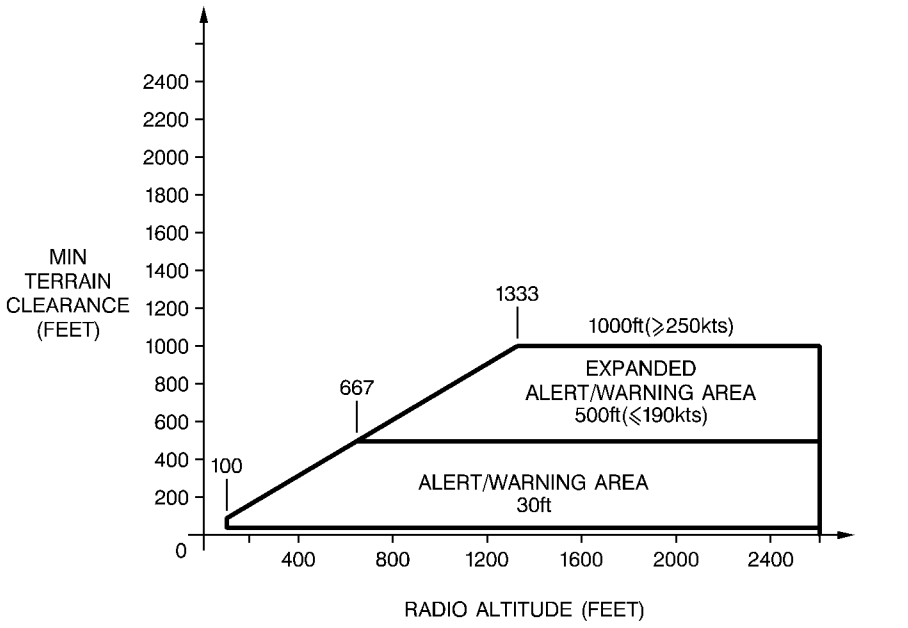
EGPWS - Unsafe Terrain Clearance - Sheet 1/2
Figure 022



BM5 34 48 00 0 DFM0 01

EGPWS - Unsafe Terrain Clearance - Sheet 2/2
Figure 023

**ON A/C 101-200,

(5)Mode 5 - Descent below glide slope

(a)Mode 5 provides two levels of warning when the aircraft flight path descends below the glide slope beam on front course ILS approaches. The upper limit of 1000 ft. nominal allows the capture of the beam before enabling this mode. Higher upper limits are used at certain airports to increase the warning envelope. The deviation boundaries are shown in dots below the beam where one dot equals 0.0875 DDM. The first warning occurs whenever the aircraft is more than 1.3 dots below the beam. It is called a soft glide slope warning because the volume level of the GLIDE SLOPE warning is approximately one half (- 6 db) that of the other warnings. A second warning boundary occurs below 300 ft. radio altitude and below 2 dots deviation. It is called loud glide slope because the volume level is increased to that of the other warnings.

(b)Both boundaries allow additional deviation below 150 ft. of radio altitude to allow for normal beam variations near the threshold.

(c)The basic Audio De-Clutter feature provides "GLIDESLOPE" message logic which suppresses the aural alert after one message has been given. Follow-on alerts are only allowed when the aircraft descends lower on the Glideslope beam by approximately 20 per cent. The alert lamp remains on until the excessive "Fly-Up" condition has been corrected. The aural alerts are provided continuously once the aircraft exceeds 2 dots "Fly-Up". Below 300 ft. AGL the messages speed up as altitude is lowered or deviation is increased. Actual time between "GLIDESLOPE" messages for these conditions is controlled by the equation :

$$\text{PAUSE (SEC)} = \frac{\text{RADIO ALTITUDE (FT)}}{\text{GLIDESLOPE DEVIATION (DOTS FLY UP)}} \times 0.0067$$

Additionally, the Audio De-Clutter feature allows for Mode 5 "GLIDESLOPE" alerts to occur during penetration of the Mode 1 outer envelope while the Mode 1 "SINKRATE" audio is suppressed.

(d)The GLIDESLOPE warning can be manually cancelled by the crew. This can be done at any time below 2000 ft. nominal radio altitude. Cancel can be reset by ascending above 2000 ft. nominal, or descending below 30 ft..

(e)The change from constant deviation to a slope below 150 ft. radio altitude is shown along with the constant separation 0.7 dots between the two boundaries. A delay of approximately 0.8 second is inserted between the warning output and the enabling logic during a warning condition. The delay shall also turn off the warning output when two

successive samples show a loss of the enabling logic. The repetition rate of the glide slope message is controlled by the radio altitude and the glide slope deviation as shown in the equation above.

(f)The gear-down logic requirement for mode 5 is deleted at certain airports.

**ON A/C 101-200,

(Ref. Fig. 024)

**ON A/C 101-200,

C. Envelope Modulation

(1)Background

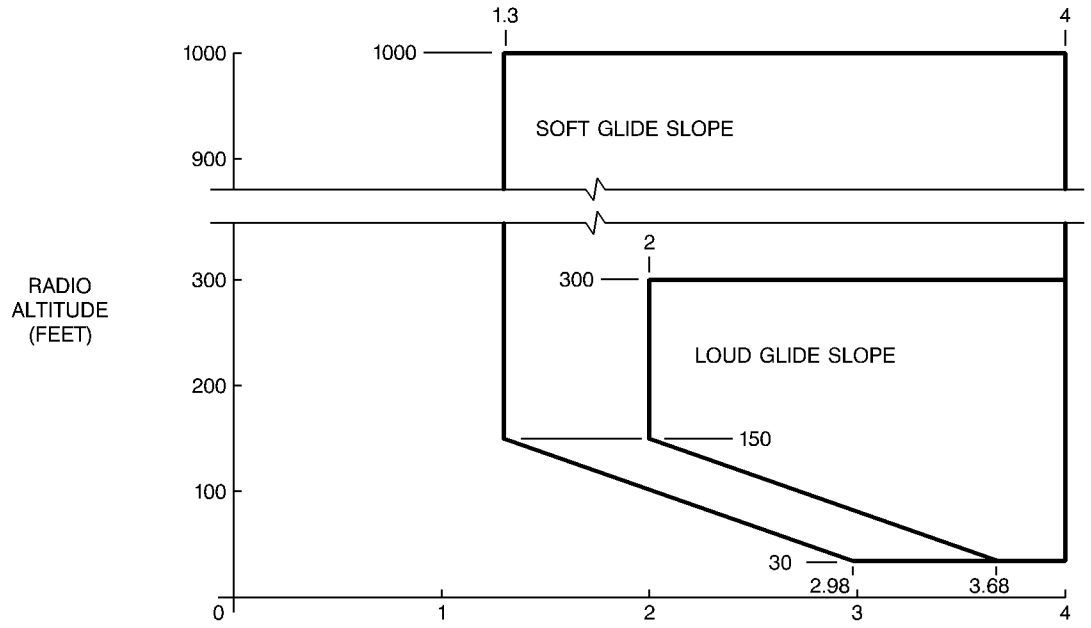
During the past 20 years, experience with GPWS has shown that normal approaches to certain airports can be incompatible with the normal warning envelopes and signal filtering.

The envelope modulation feature provides improved alert/warning protection at some key locations throughout the world, while improving nuisance margins at others. This is made possible with the use of navigational signals from modern inertially based navigation equipment. This feature utilizes updated Flight Management System navigational signals.

A number of enhancements to the envelopes and filters have been developed during this time in an attempt to accommodate these few airports, without compromising the overall GPWS effectiveness for all the other "normal" airport approaches. However, there remain a limited number of cases which are still not satisfactory despite these efforts. All of the noticeable cases have been due to nuisance warnings for approaches and departures at particular airports. The majority of nuisance warnings involves mode 2 closure rate due to terrain under the approach path or rising terrain just before the runway threshold. Others involve mode 4 terrain clearance warnings during initial approach. A few mode 1 warnings are the results of steeper than normal approaches over terrain which slopes down to the runway at some airports.

A different type of case is the inadequate warning protection during ILS approaches because Mode 5 is limited to less than 1000 ft. Radio altitude. There are airports located at a significantly higher altitude than the surrounding terrain. In some instances this difference is over 1000 ft., thus requiring the aircraft to be below the runway elevation before a mode 5 warning is possible during most of the approach.

Until recently there has been no reasonable way to accomodate these few special cases without compromising the EGPWC at all other airports.



BM5 34 48 00 0 DEM0 01

EGPWS - Descent Below Glideslope
Figure 024

What is needed is the ability to recognize when the aircraft is approaching one of these airports and then adjust the warning criteria to suit the particular approach.
The availability of accurate, low drift, latitude and longitude information from the latest generation inertial navigation equipment now makes individual airport recognition possible. After recognizing the approach to or departure from one of these airports, it is also important to verify the aircraft is at a reasonable altitude before desensitizing any warning criteria. If the aircraft is already low, further warning reduction is not desirable. This requires the use of Corrected Altitude signals.

(2)Functional description

Furthermore, in order to prevent inadvertent activation of envelope modulation, cross checks must be made which validate the navigational and altitude information. This requires a cross check to other ground based navigational aids.

Corrected Altitude information from the ADC is used. This data can be either QNH or QFE corrected (selectable via program pin). This altitude information is verified in one of two ways :

- For ILS approaches, the Glideslope deviation is used to establish that adequate terrain clearance exists (i.e. a "normal" approach). Consequently, errors in altitude data will not enable envelope modulation during an unsafe condition,
- When ILS information is not available, stored terrain elevation data is matched against computed elevation data (i.e. Corrected Altitude - Radio Altitude) to verify altitude. This is done for a "snapshot" location immediately prior to the envelope modulation area.

The following input data are used for airport recognition :

- latitude position from the FMC or the IRS,
- longitude position from the FMC or the IRS,
- glide slope deviation from the ILS,
- localizer deviation from the ILS,
- aircraft magnetic track angle from the FMC or the IRS,
- runway course from the ILS,
- corrected barometric altitude from the ADC,
- QNH or QFE mode of baro altitude correction via program pin. QNH mode is baro altitude correction to sea level. QFE mode is selected with a program pin for baro altitude correction to the airport field elevation,
- radio altitude.

Latitude and longitude data are continuously monitored for the airport locations. Additional data processing for envelope modulation is not required until the aircraft approaches one of the envelope modulation areas. Then the other data inputs are checked for a "normal" approach before any warning envelopes are modulated. The FMC is the preferred source for latitude and longitude data because these data were corrected for the normal drift of the IR basic latitude and longitude data.

**ON A/C 101-200,

D. Enhanced Features

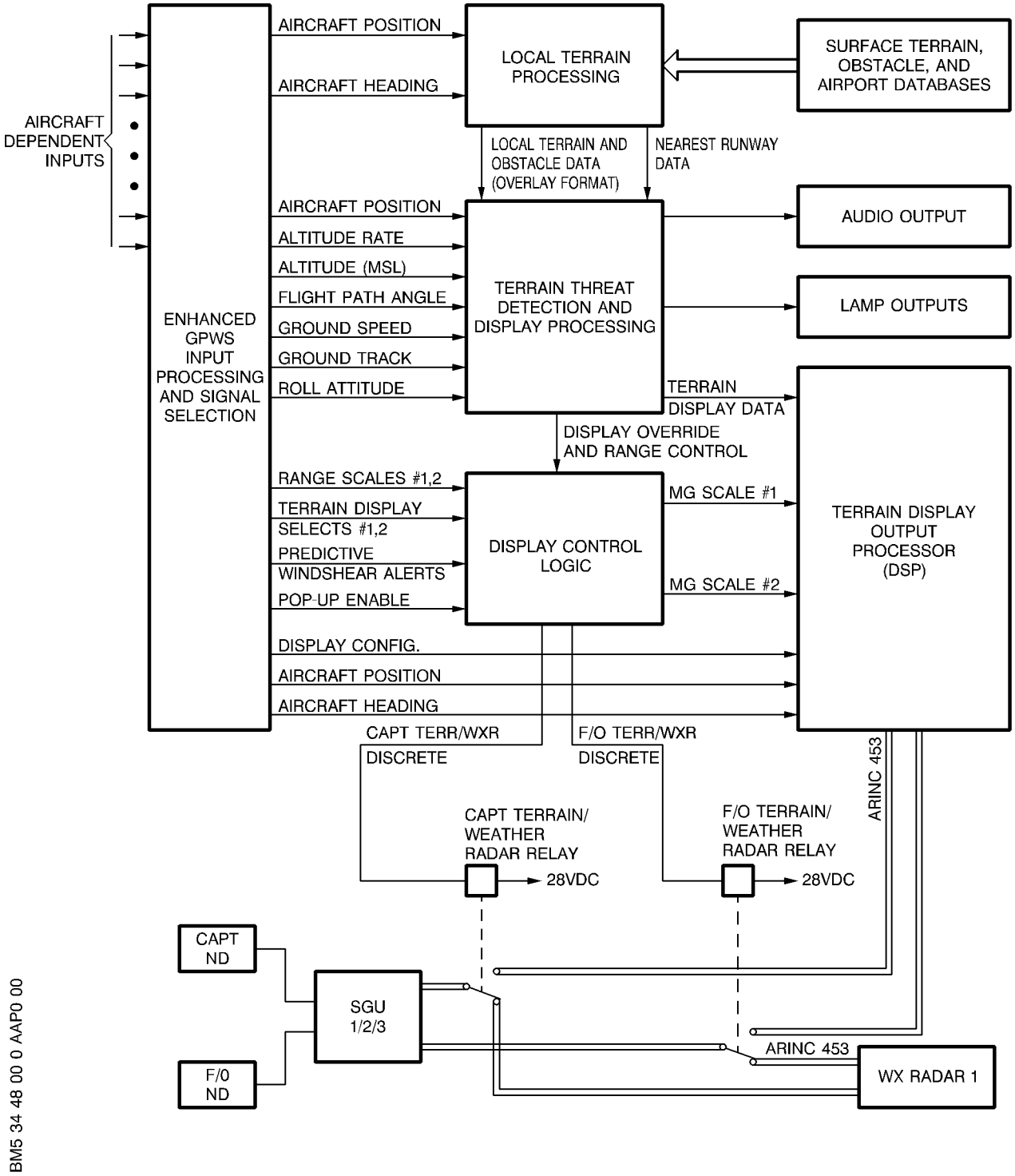
(1)Terrain Awareness and Display (TAD) Functions
The Terrain Awareness component of the EGPWS is divided into functional blocks with an interface to navigation display.
(Ref. Fig. 025)
The highlighted blocks monitor aircraft position with respect to local terrain data base and provide rapid audio and visual alerts when a terrain threat is detected. Terrain threats are recognized and annunciated when terrain violates specific computed envelope boundaries forward of the aircraft path. Provision has been included for a future obstacle data base providing similar annunciation when cataloged obstacles violate the same envelope boundaries.
The Terrain Awareness alert lamps and audio outputs behave in the same manner as the standard GPWS mode alerts. A Terrain Caution Alert or Terrain Warning Alert will initiate a specific audio alert phrase.
Complementing the terrain threat alerts, the EGPWS also maintains a synthetic image of local terrain forward of the aircraft for display on EFIS Navigation Displays (NDs).
The EGPWS is configured to automatically de-select the Weather Display and pop-up a display of the terrain threats when they occur.
The logic used provides an external input for predictive windshear alerts that can override a Terrain Display and revert to the weather display with the corresponding windshear data.
The EGPWS provides two external display outputs, each with independent range-scaling control in the same fashion as a weather radar on both NDs. Changes of range scaling to one ND do not affect the other display. Each of these two independant outputs may be used to drive more than one display.

(a)EGPWS Input Processing and Signal Selection

**ON A/C 101-200,

(Ref. Fig. 025)

**ON A/C 101-200,



EGPWS - Terrain Awareness Functions
Figure 025

The EGPWS Input Processing and Signal Selection function conditions and formats aircraft data into proper form for use by the EGPWS while insulating the EGPWS from variations in aircraft type and configuration.

1 Aircraft Data Inputs
Aircraft Position latitude and longitude are required for Terrain Awareness operation and are received from the Flight Management System (FMS). The Terrain Threat Detection and Display processing will be disabled if the accuracy of the FMS position is not sufficient. This is indicated to the flight crew by illumination of both STBY indications in TERR switches. Additionally, aircraft Ground Track and Ground Speed data are received from the IRS. The Aircraft Altitude MSL is received from the Air Data Computer 1. Other aircraft inputs include Aircraft Heading (from the IR), Roll Altitude (from the IR) and Flight Path Angle (Gamma, derived by the EGPWC).

2 Control Inputs
Installations provide discrete Terrain Display Select switches (TERR) in the cockpit for each display. These are momentary contact switches that are processed by the EGPWS Input Processing and Signal Selection block as input to Display Control Logic. Additionally, for aircraft with predictive windshear radar capability, a Windshear Override boolean is computed using alert level bits from label 077 on WXR hazard bus for the Display Control Logic.
This boolean allows the EGPWC to manage priority between EGPWC alerts and PWS alerts. The installation requires input of cockpit-selected range scales provided by EFIS Control Panel for each ND.

(b)Local Terrain Processing
The Local Terrain Processing block extracts and formats local topographic data and terrain features from the related databases creating a set of Digital Elevation Matrix Overlays for use by the Terrain Threat Detection and Display Processing functions. Additionally, data for the nearest runway are also extracted for use by the Terrain Threat Detection and Display Processing functions. Processing for each topographic database and the runway database are described in the following sub-sections.

1 Terrain Surface Data
Local Terrain Processing of topographic surface data updates a set of Digital Elevation Matrix Overlays that are positioned with respect to Aircraft Position. Each matrix element contains the highest terrain altitude with respect to mean sea level in that element's area. Elements where terrain data are not available are marked invalid. These unknown data are displayed in magenta low density on ND whatever the altitude.

2 Obstacle Data
In addition to terrain surface data, provisions are made for future use of an Obstacle Database providing obstacle data in the vicinity of

major airports. Local Terrain Processing will update a dedicated overlay within the Digital Elevation Matrix Overlays with local obstacle altitude data.

3 Nearest Runway Data
Data for the nearest runway are extracted and processed for use by the Terrain Threat Detection and Display Processing functions. Data are extracted from the same Airport Database used by the Terrain Clearance Floor functions. This database contains data on all hard-surface runways 3500 feet or more in length with published coordinates. The contents of the database are processed by the Local Terrain Processing into Nearest Runway Center position, Nearest Runway Threshold position, and Nearest Runway Altitude for use by the EGPWS. These data are updated when the Terrain Threat Detection and Display Processing functions are performed.

(c)Terrain Threat Detection
The Terrain Threat Detection and Display Processing block performs the threat analysis on the terrain data within computed caution and warning envelope boundaries below and forward of the aircraft path. Results of these threat assessments are combined with background terrain data and data for the nearest runway and formatted into a terrain display image which can be displayed on navigation display in place of the weather image. In the event of terrain caution or warning conditions, a specific audio alert is triggered and the terrain display image is enhanced to highlight each of the types of terrain threats.

1 Terrain caution and warning envelopes
(Ref. Fig. 026)

a Caution Altitude Floor
The Caution Altitude Floor (or Terrain Floor) is computed as a function of Aircraft Altitude with respect to Nearest Runway Altitude and range to the Nearest Runway Threshold position. This parameter represents a distance below the aircraft. The relationship to the nearest runway threshold location prevents undesired alerts when the aircraft is taking off or landing at an airport. The system is compatible with terrain clearances allowed for by Regulator Approach and Departure Design criteria.

b Caution Look Ahead Distance
The Caution Look Ahead Distnace is computed form aircraft ground speed and turn rate to provide an advanced caution with adequate time for the crew to react safely. Depending on the situation this distance roughly corresponds to between 40 and 60 seconds for advance alerting.

c Warning Altitude Floor
The Warning Altitude Floor is set to a fraction of the Caution Altitude Floor, as illustrated in the upper part.
The Warning Altitude Floor is computed as a function of Aircraft

Altitude with respect to Nearest Runway Altitude and range to the Nearest Runway Threshold position. This parameter represents a distance below the aircraft. The relationship to the nearest runway threshold location prevents undesired alerts when the aircraft is taking off or landing at an airport.

d Warning Look Ahead Distance
The Warning Look Ahead Distance is a fraction of the Caution Look Ahead Distance (computed from aircraft ground speed and turn rate) to provide an advanced warning with adequate time for the crew to react safely.

**ON A/C 101-200,

**ON A/C 101-104,

(d)Terrain displays and alerts
The Terrain Awareness Alerting and Display function maintains a Background Display of local terrain forward of the aircraft for cockpit display. In the event of terrain caution or warning conditions, an aural alert and lamp outputs are triggered. The background image is then enhanced to highlight related terrain threats forward of the aircraft.
The background terrain is depicted as variable density dot patterns in green, yellow or red. The density and color being a function of how close the terrain is relative to aircraft altitude. Terrain alerts are depicted by painting the threatening terrain as solid yellow or red.
The set of Digital Elevation Matrix Overlays is processed by the terrain display algorithms into a matching set of Display Matrix Overlays and passed to the Radar Display Output Processor. The display Matrix Overlays hold display attributes rather than altitude for each matrix element. These attributes are computed for the background and terrain threat areas and kept small (one byte) to reduce memory requirements and transfer time to the Radar Display Output Processor.
The Aircraft Position and Aircraft Heading are used at the Radar Display Output Processor to extract a specific sweeping image ahead of the aircraft from the display overlays.
Each element of the output Display Matrix Overlays holds a single display attribute byte with fields for the colors, patterns, and symbols shown in the following table :

Color	Threat
Solid Red	Warning terrain (approximately 30 seconds from impact)

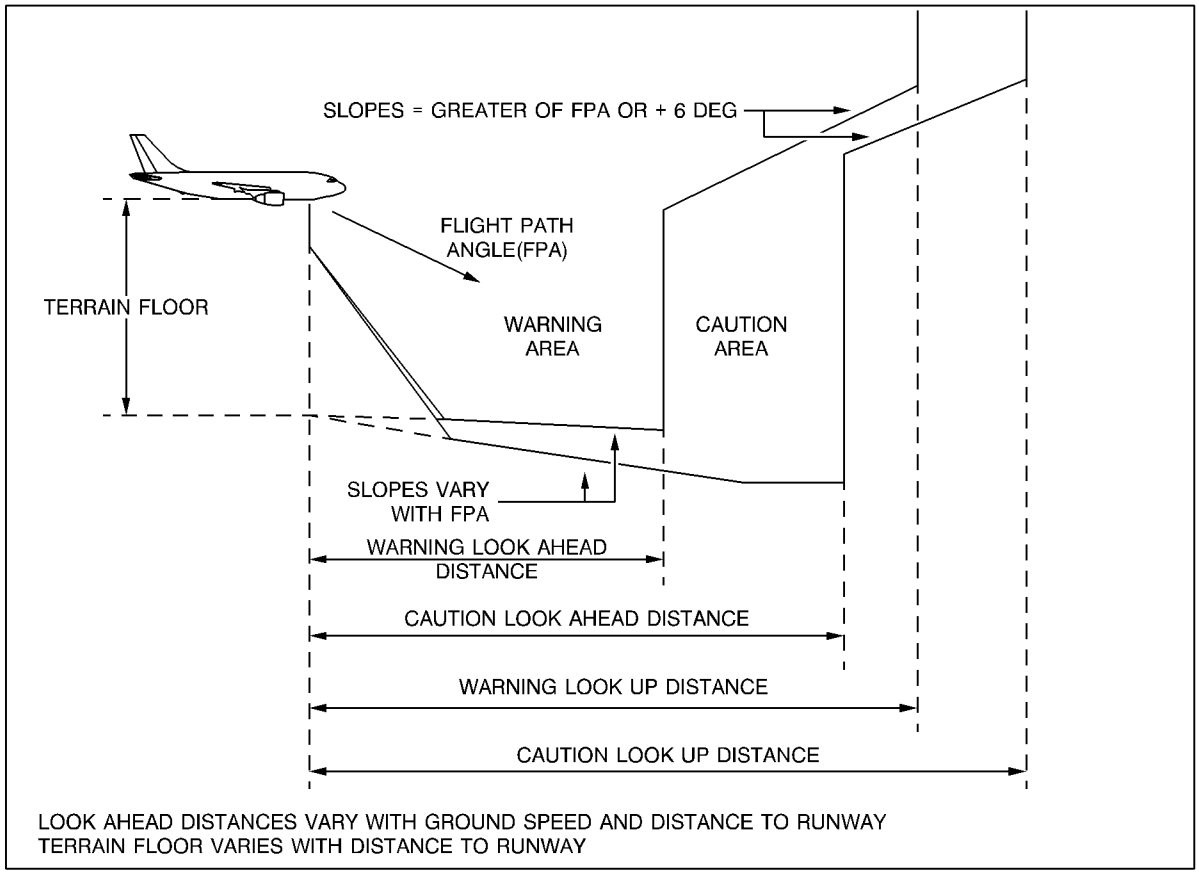
Color	Threat
Solid Yellow	Caution Terrain (approximately 60 seconds from impact)
High Density Red	Terrain that is more than 2000 feet above aircraft altitude
High Density Yellow	Terrain that is between 1000 and 2000 feet above aircraft altitude
Medium Density Yellow	Terrain that is 500 (250 with gear down) feet below to 1000 feet above aircraft altitude
Medium Density Green	Terrain that is 500 (250 with gear down) feet below to 1000 below aircraft altitude
Light Density Green	Terrain that is 1000 to 2000 feet below aircraft altitude
Black	No close terrain
Light Density Magenta	Unknow terrain

**ON A/C 101-200,

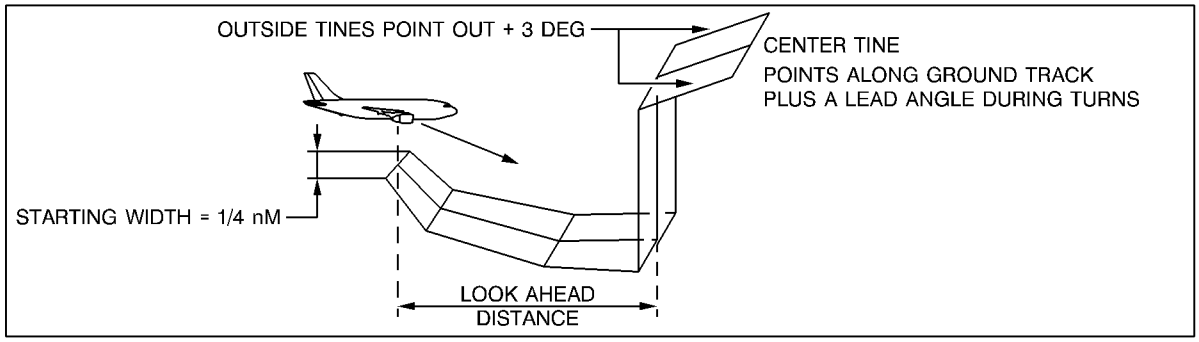
Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

(d)Terrain/obstacle displays and alerts (option)
The Terrain Awareness alerting and Display function maintains a background display of local terrain forward of the aircraft for cockpit display. In the event of terrain or obstacle caution or warning conditions, an aural alert and lamp outputs are triggered. The background image is then enhanced to highlight terrain or obstacle threats forward of the aircraft. Obstacle threats forward of the aircraft are also enhanced if the adjacent terrain altitude is within a lower terrain layer, or if the adjacent cells are not illuminated. Obstacle enhancement is only applicable to the 15, 30 and 60 arc second tiers.
The background terrain is depicted as variable density dot patterns in green, yellow or red. The density and color vary according to how close the terrain or obstacle is in relation to



TERRAIN CAUTION AND WARNING ENVELOPE BOUNDARIES



TERRAIN DETECTION ENVELOPE - PERSPECTIVE VIEW

BM5 34 48 00 0 AAQ0 00

EGPWS - Terrain Detection Envelope
Figure 026

aircraft altitude. Additionally, the display of terrain based on absolute terrain elevation is provided if the optional Peaks mode is enabled. Terrain and obstacle alerts are depicted by displaying the threatening terrain as solid yellow and/or solid red.

The terrain display algorithms process the set of digital elevation matrix overlays into a matching set of display matrix overlays and passed to the radar display output processor. The display matrix overlays hold display attributes rather than altitude for each matrix element. These attributes are computed for the background and terrain threat areas and are kept small to reduce memory requirements and transfer time to the radar display output processor. The aircraft position and aircraft heading are used at the radar display output processor to extract the radar-like sweeping image ahead of the aircraft from the display overlays.
Each element of the output display matrix overlays holds a single display attribute byte with fields for the colors, patterns, and symbols shown in the following table:

Color	Threat
Solid Red	Warning terrain (approximately 30 seconds from impact)
Solid Yellow	Caution terrain (approximately 60 seconds from impact)
High Density Red	Terrain that is more than 2000 feet above aircraft altitude
High Density Yellow	Terrain that is between 1000 and 2000 feet above aircraft altitude
Medium Density Yellow	Terrain that is 500 (250 with gear down) feet below to 1000 feet above aircraft altitude
Solid Green	(Peaks Only) Highest terrain not within 500 ft. (250 ft. gear down) of aircraft altitude. Mainly appears with dotted yellow terrain when the aircraft altitude is within 500 ft (250 ft with gear down) of terrain.
High Density Green Dots (1)	Terrain that is 500 ft (250 ft. with gear down) below to 1000 ft. below aircraft altitude.
	(Peaks Only) Terrain that is the middle elevation band when there are no red or yellow terrain areas within range on the display.
Low Density	Terrain that is 1000 to 2000 feet below

Color	Threat
Green Dots	aircraft altitude.
	(Peaks Only) Terrain that is the middle elevation band when there are no red or yellow terrain areas within range on the display.
Black	No close terrain
Low Density Cyan Dots	(Peaks Only) Terrain elevation equal to 0 feet MSL.
Light Density Magenta	Unknown terrain

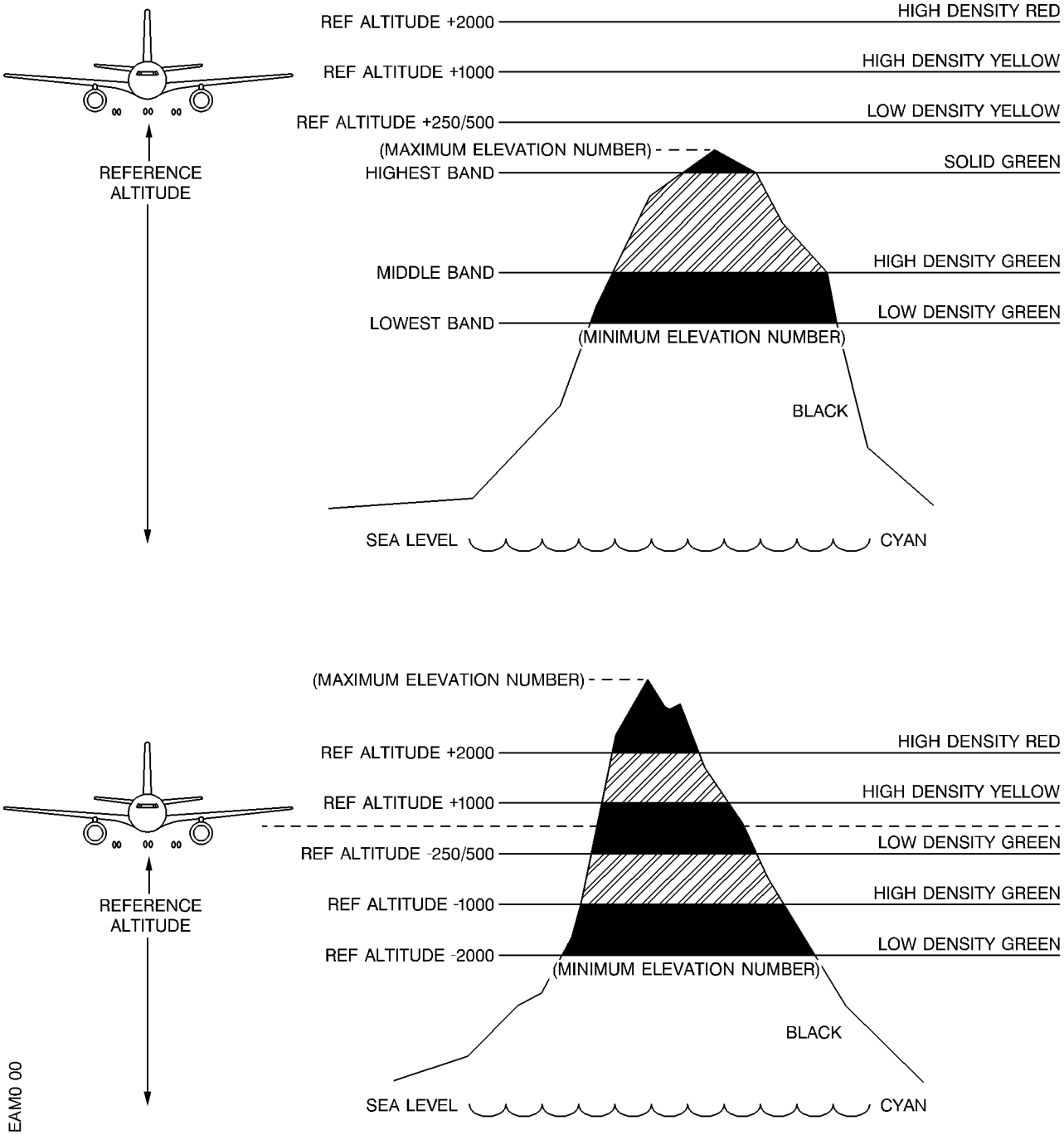
**ON A/C 101-200,

Post SB 34-2206 For A/C 101-200,

(Ref. Fig. 027)

**ON A/C 101-200,

(Ref. Fig. 028)



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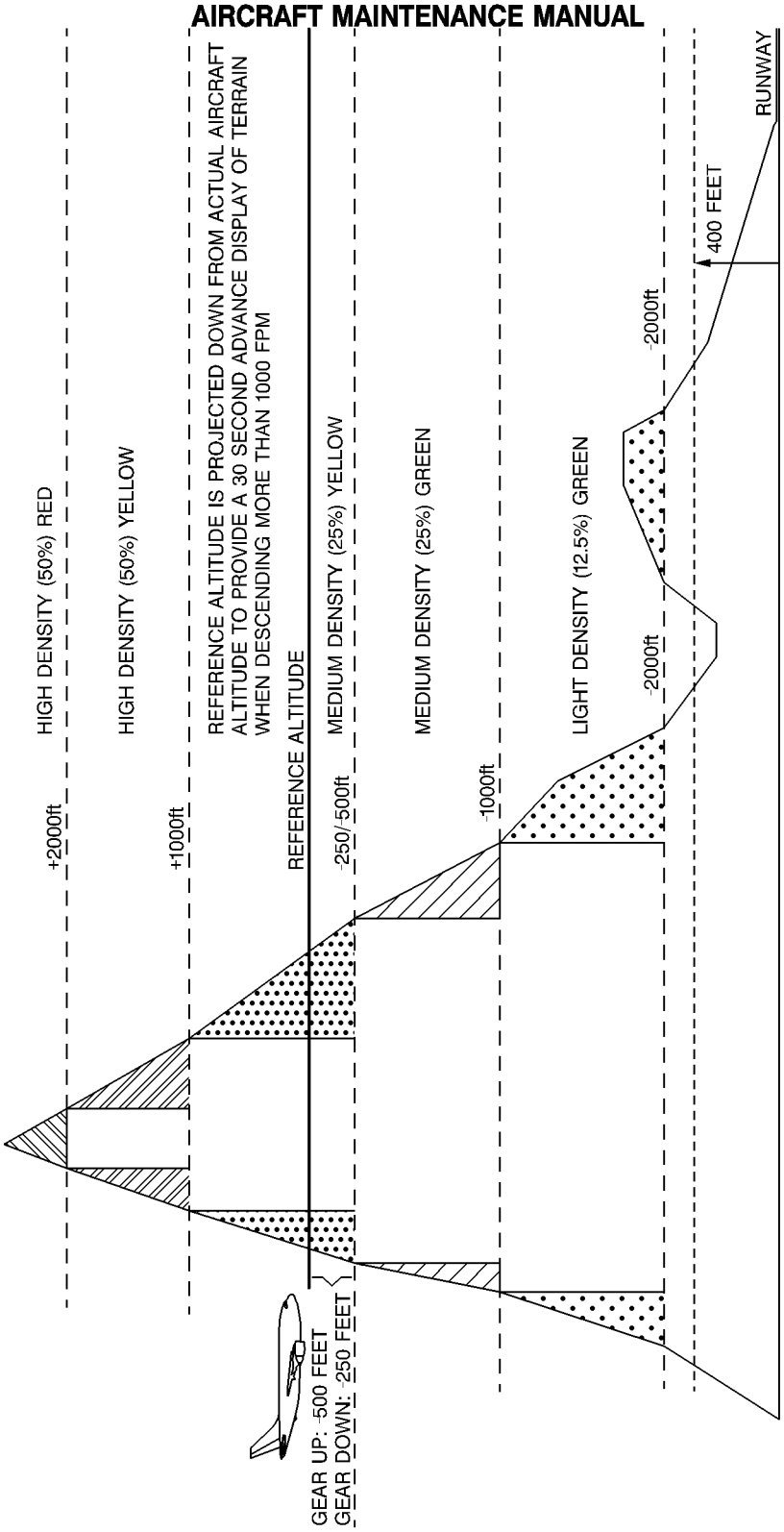
REFERENCE ALTITUDE IS PROJECTED DOWN FROM ACTUAL AIRCRAFT ALTITUDE TO PROVIDE A 30 SECOND ADVANCE DISPLAY OF TERRAIN WHEN DESCENDING MORE THAN 1000 FPM.
TERRAIN IS NOT SHOWN IF IT IS BELOW THE LOWEST BAND AND/OR IS WITHIN 400 FEET OF THE RUNWAY ELEVATION NEAREST THE AIRCRAFT.

EGPWS - Peaks Terrain Background Display Legend
Figure 027



BM5 34 48 00 0 AAR0 00

EGPWS - Terrain Background Display Legend
Figure 028

**ON A/C 101-104,

1 Background display
(Ref. Fig. 029)
The Background Display is computed from the Aircraft Altitude with respect to the terrain data in the Digital Elevation Matrix Overlays. Where terrain data are available and sufficiently close to the Aircraft Altitude, they are presented in Background Color dot patterns reflecting the projected separations shown in this illustration :
(Ref. Fig. 028)
Different dot density patterns and colors are used to represent terrain altitude bands with respect to the aircraft. Areas with no terrain data available are painted with the low Density Magenta. Known terrain sufficiently below the Aircraft Altitude is black.

NOTE : Terrain is not shown if more than 2000 feet below reference altitude
Terrain is not shown if terrain elevation is within 400 feet of runway elevation nearest the aircraft.
Terrain is not shown when ROSE or PLAN mode is selected on EFIS Control Panel.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

1 Background display
(Ref. Fig. 030)
There are two different background Terrain Awareness display modes: standard and Peaks. For both modes the background display is computed from the aircraft altitude with respect to the terrain data in the digital elevation matrix overlays.
- Standard mode
Terrain is displayed using colors and shading patterns corresponding to the vertical displacement between the terrain elevation and the current aircraft altitude. Red and yellow dot patterns indicate terrain near or above the current altitude of the aircraft. Solid yellow and red colors indicate caution and warning areas with respect to the flight path of the aircraft.
High and low density green display patterns indicate terrain that is below the aircraft and within 2000 ft of the

aircraft altitude. Terrain more than 2000 ft below the aircraft is not displayed and the terrain display is typically blank during the enroute portion of the flight.

- Peaks mode

The Peaks display option is available on Airbus aircraft equipped with EIS 2 LCD displays. The Peaks terrain display adds additional density patterns and level thresholds to the standard mode display levels and patterns. These additional levels are based on absolute terrain elevations in relation to the range and distribution of terrain in the display area. The Peaks display is thus a merged display applicable to all phases of flight. At altitudes safely above all terrain for the display range chosen, the terrain is displayed independently of aircraft altitude emphasizing the highest and lowest elevations to provide increased situational awareness. This increased awareness can be particularly valuable to the flight crew in the event of an unplanned descent or off-route deviation and for the purpose of previewing terrain prior to descent.

The Peaks display includes a high green level to indicate the highest non-threatening terrain. The standard lower density green display patterns indicate mid and upper terrain in the display area as well as terrain that is within 2000 ft of the aircraft. The red and yellow dot patterns are unchanged and continue to indicate terrain that is near or above the current altitude of the aircraft. Solid yellow and red colors are also unchanged and continue to indicate caution and warning areas in relation to the flight path of the aircraft. Terrain identified as water (0 ft MSL) is displayed as cyan dots. The Peaks display is prioritized such that higher level colors and densities override lower color and densities for maximum situational awareness of the most significant terrain in relation to the altitude and flight path of the aircraft.

(Ref. Fig. 027)

With the Peaks display, two elevation numbers indicating the highest and lowest terrain currently being displayed are shown on the display. The elevation numbers indicate terrain in hundreds of feet above sea level (MSL). The terrain elevation numbers are displayed with the highest terrain number on top, and the lowest terrain number beneath it. The highest terrain number is shown in the same color as the highest terrain color pattern on the display, and the lowest terrain number is shown in the color of the lowest terrain color pattern shown on the display. A single elevation number is displayed when the screen is all black or blue as a result of flying over water or relatively flat terrain where there is no appreciable difference in terrain elevations. The elevation numbers on the display are an additional indication that the terrain display is selected.

**ON A/C 101-104,

(Ref. Fig. 029)

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

(Ref. Fig. 030)

**ON A/C 101-104,

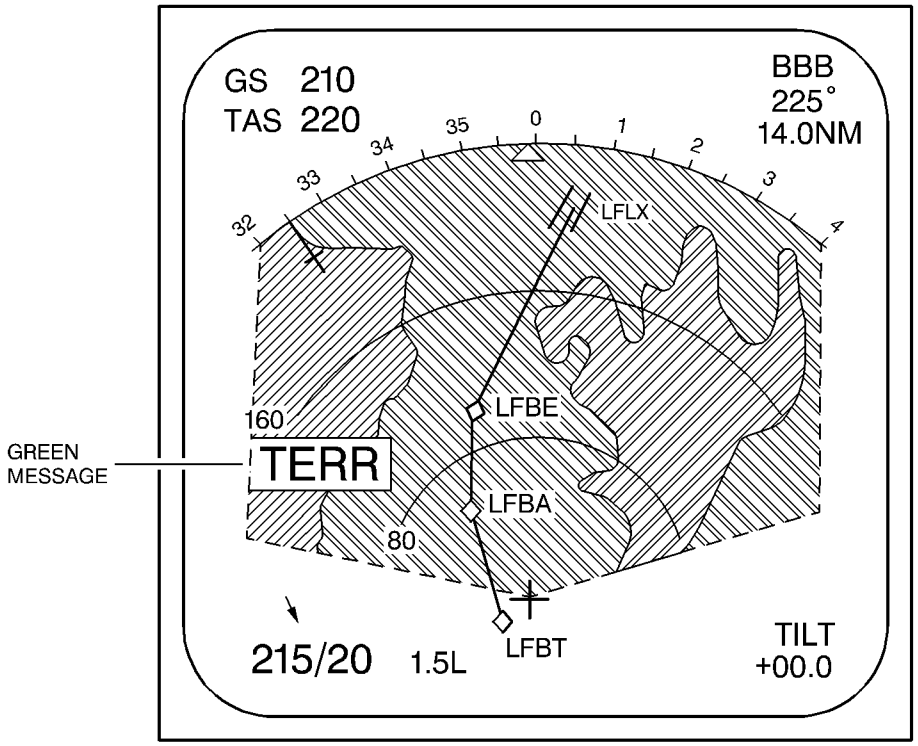
2 Terrain warning alert
When the conditions have been met to generate a Terrain Warning Alert, a specific audio alert and light output is triggered and the background image is enhanced to highlight the terrain caution and warning threats.
At the start of a Terrain Warning Alert, the Terrain Awareness function triggers the Warning Audio Alert phrase "TERRAIN AHEAD, PULL UP". The phrase is repeated continuously while within the Terrain Warning Envelope.
During a Terrain Warning Alert, the GPWS legend on indicator lights 3WZ and 4WZ is on.
During a Terrain Warning Alert, areas where terrain violates the Terrain Warning Envelope along the aircraft track, and within plus or minus 90 deg. of the aircraft track, are painted with the Warning Color 100 per cent red.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

2 Terrain and Obstacle caution alert (option)



HIGHT DENSITY RED AREA

HIGHT DENSITY YELLOW AREA

MEDIUM DENSITY GREEN AREA

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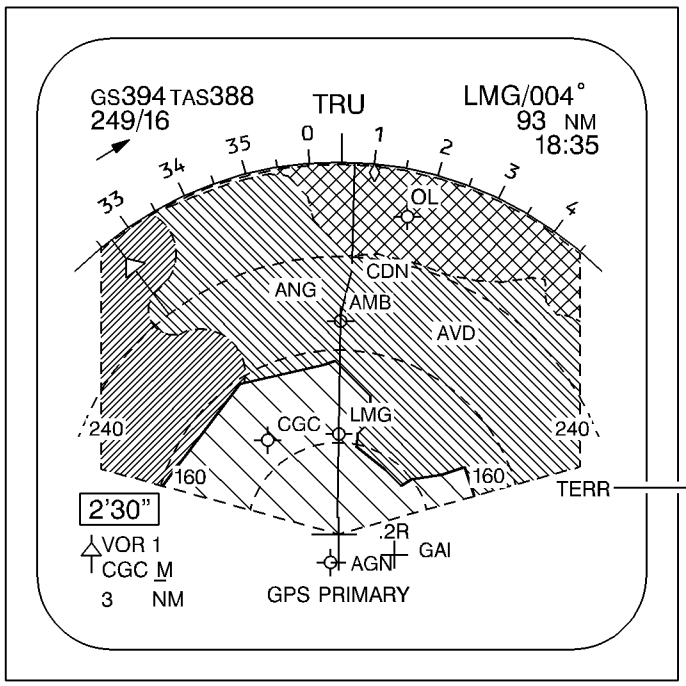
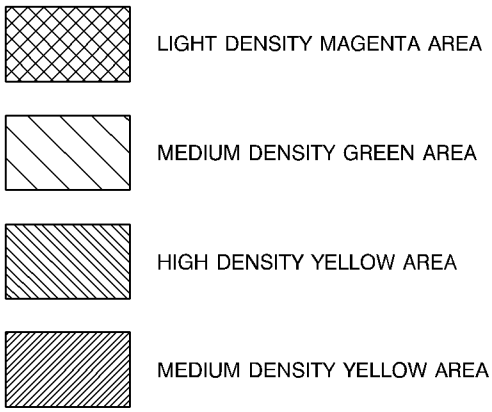
EGPWS - Terrain Background Display on ND
Figure 029





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EGPWS - Terrain Background Display on ND
Figure 030

(Ref. Fig. 031)
When the conditions have been met to generate a terrain or obstacle caution alert, a specific audio alert and light output is triggered and the background image is enhanced to highlight the terrain caution threats.
At the start of a terrain caution alert, the Terrain Awareness function triggers the caution audio alert phrase **TERRAIN AHEAD, TERRAIN AHEAD.** The phrase is repeated after seven seconds if still within the terrain caution envelope. The Terrain Awareness function responds to an obstacle caution alert by triggering the obstacle caution audio alert phrase **OBSTACLE AHEAD, OBSTACLE AHEAD.** The phrase is repeated after seven seconds if still within the terrain caution envelope.
During a terrain caution alert or obstacle caution alert, the **GPWS** legend of the **PULL UP/GPWS** pushbutton switches is on.
During a terrain caution alert, areas where terrain violates the terrain caution envelope along the aircraft track, and within plus or minus 90 deg. of the aircraft track, are painted with the caution color 100 per cent yellow.
During an obstacle caution alert, areas where an obstacle violates the terrain caution envelope along the aircraft track, and within plus or minus 90 deg. of the aircraft track, are displayed with the caution color yellow.

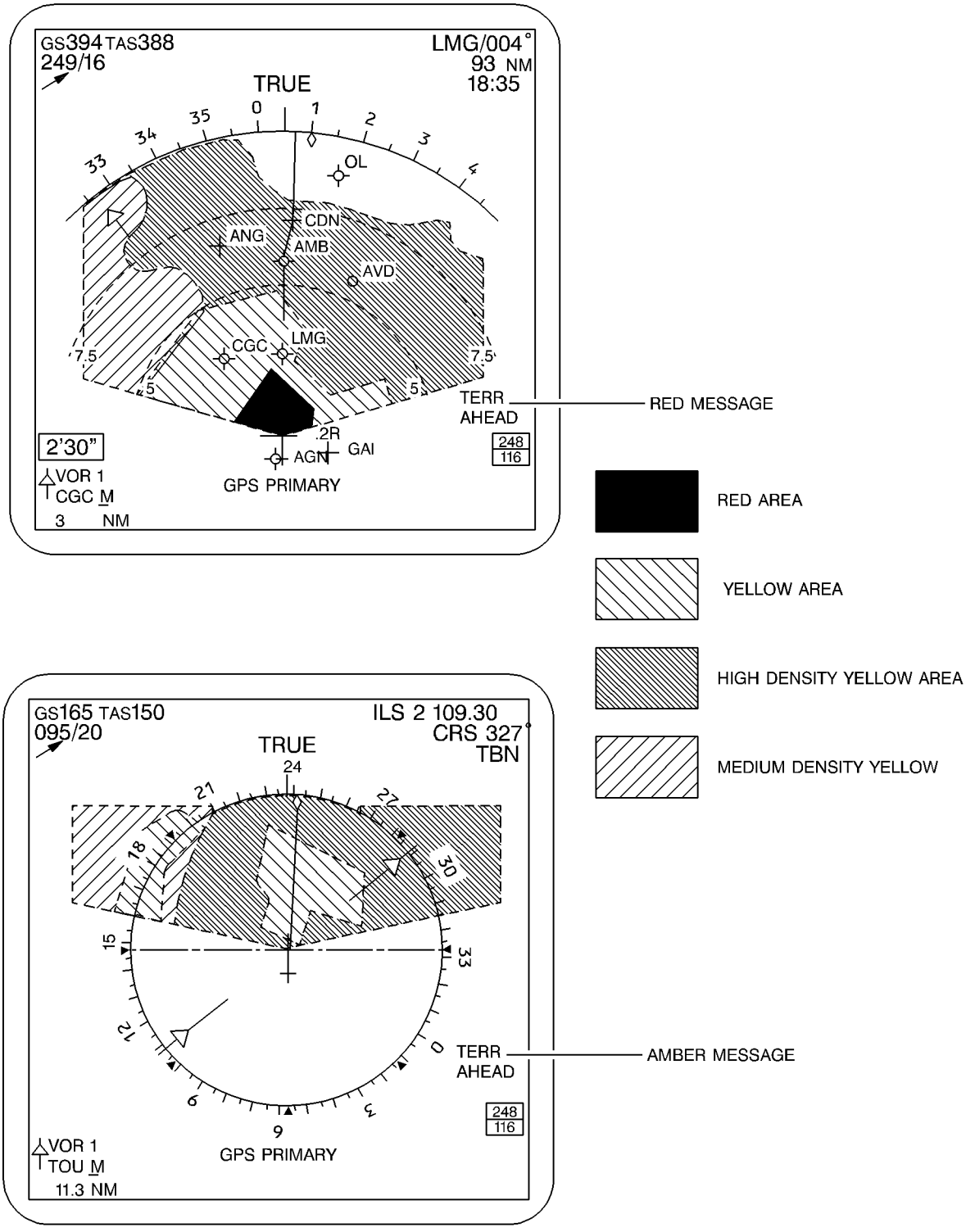
**ON A/C 101-200,

Post SB 34-2206 For A/C 101-200,

**ON A/C 101-200,

Post SB 34-2206 For A/C 101-200,

3 Terrain and obstacle warning alert
(Ref. Fig. 031)
When the conditions have been met to generate a terrain or obstacle warning alert, a specific audio alert and light output is triggered, and the background image is enhanced to highlight the terrain or obstacle caution and warning threats.
At the start of a terrain warning alert, the Terrain Awareness function triggers the warning audio alert phrase **TERRAIN AHEAD, PULL UP.** The phrase is repeated continuously while within the terrain warning envelope. The Terrain Awareness function responds to an obstacle warning alert by triggering the obstacle warning audio alert **OBSTACLE AHEAD, PULL UP.** The phrase is repeated continuously while within the terrain warning envelope.



BM5 34 48 00 0 ECM0 00

EGPWS - Terrain Background Display on ND
Figure 031

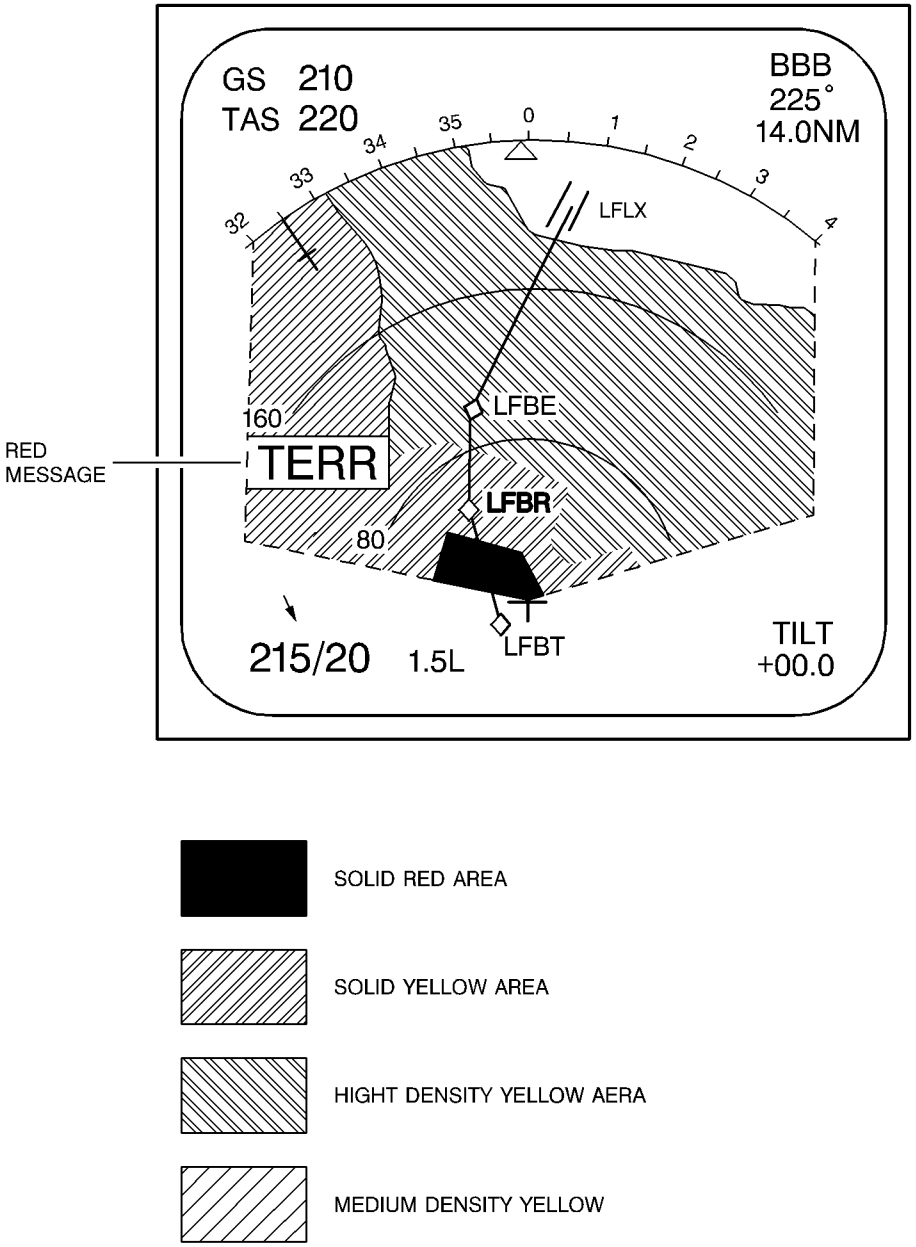
During a terrain or obstacle warning alert, the GPWS legend of the PULL UP/GPWS pushbutton switches is on.
During a terrain warning alert, areas where terrain violates the terrain warning envelope along the aircraft track, and within plus or minus 90 deg. of the aircraft track, are displayed with the warning color 100 per cent red.
NOTE : - Terrain is displayed on the NDs only if the ARC or ROSE mode is selected on the FCU.
- When an alert (caution or warning) occurs and the FCU mode is not a correct mode (ARC or ROSE), the message TERR. CHANGE MODE is displayed on the NDs.
- When an alert (caution or warning) occurs and the range selected on the FCU is 160 or 320 NM, the message TERR. REDUCE RANGE is displayed on the NDs.

**ON A/C 101-200,

(Ref. Fig. 032)

**ON A/C 101-104,

(e)Terrain Database
Local Terrain Processing extracts and formats local topographic terrain data from the EGPWS Terrain Database for use by the Terrain Threat Detection and Display Processing functions. This Terrain Database divides the earth's surface into grid sets referenced horizontally on the geographic (latitude/longitude) coordinate system of the WGS-84. Elements of the grid sets record the highest terrain altitude (above MSL) in that element's respective area. Grid sets vary in resolution depending on geographic location. Because the overwhelming majority of "Controlled Flight into Terrain (CFIT)" accidents occur near an airport and the aircraft operate in closer proximity to terrain near an airport higher resolution grids are used around airports. Lower resolution grids are used outside of airport areas where aircraft altitude enroute makes CFIT accidents unlikely and for which detailed terrain features are not important to the flight crew.
Digital Elevation Models (DEMs) are available for most of the airports around the world today. In cases where the data are not currently available, DEMs are generated in-house from available topographic maps, sectional charts, and airline approach plates.
The process of acquiring, generating, assembling, and updating the database is governed by strict configuration controls to ensure the



BM5 34 48 00 0 AAT0 00

EGPWS - Warning Display on ND
Figure 032

highest level of data integrity. DEMs from external sources are inputs to this process and are checked and formatted for generation of the EGPWS Terrain Database.
The global EGPWS Terrain Data base is organized in a flexible manner. Using digital compression techniques, the complete database is stored in non-volatile memory within the LRU. Updates and additions are easily accomplished by inserting a single PCMCIA card in the card slot on the EGPWC front panel. Status LEDs on the LRU front panel allow the operator to monitor the data base load progress and completion.

(f)Obstacle Data base
Provisions are also made for future use of an Obstacle Data base providing obstacle data in the vicinity of major airports. This data base will provide altitude for man-made obstacles or groups of obstacles that protrude above the EGPWS terrain protection floors.

(2)Terrain Clearance Floor (TCF)

The Terrain Clearance Floor (TCF) alert function adds an additional element of protection to the standard Ground Proximity Warning System. It creates an increasing terrain clearance envelope around the airport runway to provide protection against CFIT situations beyond that which is currently provided. TCF alerts are based on current aircraft location, nearest runway center point position and radio altitude. TCF is active during takeoff, cruise and final approach. This alert mode complements the existing Mode 4 protection by providing an alert based on insufficient terrain clearance even when in landing configuration. Alerts for TCF illuminate GPWS cockpit lamps and produce aural messages.

(a)System inputs

The following table lists the inputs required to allow implementation of the TCF function :

Input	Source
Radio Altitude	External : Radio Altimeter
Latitude	External : FMS
Longitude	External : FMS
Runway Center Latitude	Internal : Database
Runway Center Longitude	Internal : Database
Navigation mode	FMS
Alert Envelope Parameters	Internal : Database
1/2 Runway Length	Internal : Database
System Error Factor	Internal : Database

(b)Runway Database

The TCF Runway Database consists of data records containing the position of airport runway center points along with 1/2 the runway length. The database includes all hard surface runways in the world greater than or equal to 3500 ft. in length. The process of generating this database is certified and includes an end check that validates that the data was not corrupted in the translation process. This database can be updated without affecting the customer certified system part number.

The design of the database and related software is such that additional runway records can be added in the future without alterning the code. The database provides a means of accessing the Runway Record of the runway closest to the current aircraft position.

(c)Alert Envelope
The TCF alert envelope is a circular band centered over the nearest runway.
(Ref. Fig. 034)
The distance from the runway center to the inner envelope edge is equal to 1/2 the runway length plus the Envelope Bias Factor.
Thus the inner and outer radius of the envolope are modulated based on the runway length and Envelope Bias Factor. Runway length will vary from one runway to the next, and the Envelope Bias Factor is typically 1/2 NM to 2NM and varies with position accuracy.
The outer alert envelope boundary extends to infinity, or until it meets the outer alert envelope boundary of another runway. The alert will be inhibited below Radio Altitude of 30 ft.. This cutoff value was chosen to match the current mode 4 lower cutoff value.

(d)System Outputs
When an aircraft penetrates the TCF alert envelope the following aural message will occur : "TOO LOW TERRAIN".
This aural message will occur once when initial envelope penetration occurs, and one time thereafter for each 20 per cent degradation in Radio Altitude. At the same time the GPWS legend of the GPWS/G/S indicator lights comes on. The legends will remain on until the alert envelope is exited.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2205 For A/C 101-200,

Post SB 34-2207 For A/C 101-200,

(e)Terrain Database
Local Terrain Processing extracts and formats local topographic terrain data from the EGPWS Terrain Database for use by the Terrain Threat Detection and Display Processing functions. This Terrain Database divides the earth's surface into grid sets referenced horizontally on the geographic (latitude/longitude) co-ordinate system of the WGS-84. Elements of the grid sets record the highest terrain altitude (above MSL) in that element's respective area. Grid sets vary in resolution depending on geographic location. Because the overwhelming majority of "Controlled Flight into Terrain (CFIT)" accidents occur near an airport and the aircraft operate in closer proximity to terrain near an airport higher resolution grids are used around airports. Lower resolution grids are used outside of airport areas where aircraft altitude en route makes CFIT accidents unlikely and for which detailed terrain features are not important to

the flight crew.
Digital Elevation Models (DEMs) are available for most of the airports around the world today. In cases where the data are not currently available, DEMs are generated in-house from available topographic maps, sectional charts, and airline approach plates.
The process of acquiring, generating, assembling, and updating the database is governed by strict configuration controls to ensure the highest level of data integrity. DEMs from external sources are inputs to this process and are checked and formatted for generation of the EGPWS Terrain Database.
The global EGPWS Terrain Data base is organized in a flexible manner. Using digital compression techniques, the complete database is stored in non-volatile memory within the LRU. Updates and additions are easily accomplished by inserting a single PCMCIA card in the card slot on the EGPWC front panel. Status LEDs on the LRU front panel allow the operator to monitor the data base load progress and completion.

(f)Obstacle Data base
Provisions are also made for future use of an Obstacle Data base providing obstacle data in the vicinity of major airports. This data base will provide altitude for man-made obstacles or groups of obstacles that protrude above the EGPWS terrain protection floors.

(2)Geometric Altitude
Geometric Altitude is a computed aircraft altitude designed to help to ensure optimal operation of the Enhanced GPWS Terrain Awareness and Display functions through all phases of flight and atmospheric conditions. Geometric Altitude uses an improved pressure altitude calculation, GPS altitude, radio altitude and terrain and runway elevation data to reduce or eliminate errors potentially induced in corrected barometric altitude by temperature extremes, non-standard altitude conditions and altimeter miss-sets. With the Geometric Altitude function, Enhanced GPWS can operate reliably throughout extreme local pressure or temperature variations from standard, is not susceptible to altimeter miss-sets by the flight crew and will not require any custom inputs or special procedures by the flight crew when operating in a QFE environment.

(a)Required inputs
The Geometric Altitude algorithm requires GPS altitude with Vertical Figure Of Merit (VFOM) and RAIM failure indication along with standard (uncorrected) altitude. Ground speed, roll angle, position (latitude and longitude), terrain data, radio altitude and nearest runway elevation are used indirectly and are also required. Additionally, corrected barometric altitude, static air temperature (SAT), GPS operational mode and the number of satellites tracked are used if available.
The required GPS signals are provided directly from GPIRS (IRS input bus). Standard altitude, corrected barometric altitude and SAT are provided directly from the ADC. If the SAT is not available,

geometric altitude is computed using standard altitude with a corresponding reduction in accuracy.

(b)Altitude calculation

The Geometric Altitude consists of three main functions :

- Calculation of non-standard altitude
- Calculation of the components altitudes and VFOMs
- Calculation of the final altitude signal blending.

Additional logic exists to handle reversionary modes and signal reasonable checking for each component altitude.

(Ref. Fig. 033)

1 Non-standard altitude

To support the geometric altitude function, the enhanced GPWS computes a non-standard altitude using the hydrostatic equation relating changes in height to changes in pressure temperature. Non-standard altitude uses pressure altitude, along with static air temperature, to continuously accumulate changes in geometric altitude. Since the non-standard altitude algorithm incorporates actual atmospheric temperature it does not suffer from errors due to non-standard temperatures.

Non-standard altitude is highly accurate for measuring relative vertical changes over short periods of time and distance, such as during take-off and approach. Non-standard altitude does not provide an absolute altitude and is prone to significant errors over extended periods of time and distance due to the effects of pressure gradients and long-term integration errors. Due to these limitations, non-standard altitude is not used directly, but is calibrated using additional signals and data to produce a set of component altitudes for use in the final altitude solution.

2 Computed component altitude

The enhanced GPWS generates four component altitudes that are combined, along with corrected altitude if available, to produce Geometric Altitude.

These component altitudes are :

- Runway calibrated altitude
- GPS calibrated altitude
- Radio altitude calibrated altitude
- Corrected barometric altitude.

Runway calibrated altitude is one-time calibration of non-standard altitude using airport elevation information from the internal TCF airport database. A correction factor for non-standard is computed by subtracting the runway elevation from non-standard altitude. Runway calibrated altitude is used during the take-off and climb-out portions of flight. VFOM of runway-calibrated altitude is estimated based on changes in altitude since calibration, time since calibration and distance from the runway with a minimum error of 50 ft.

GPS calibrated altitude is produced by combining GPS altitude and non-standard altitude through a complementary filter. The complementary filter is dynamically optimized to reduce errors in GPS altitude while minimizing pressure gradient and drift errors of non-standard altitude. GPS calibrated altitude is accurate through all

phases of flight and is the primary altitude source during the cruise portion of flight. GPS calibrated altitude VFOM is estimated using GPS VFOM and estimated non-standard altitude drift errors.

Radio altitude calibrated altitude is a calibration of non-standard altitude during approach using an altitude derived from radio altitude (height above terrain) and the terrain elevation data stored in the enhanced GPWS terrain database. This calibration is performed during the approach phase of flight when the aircraft is within a minimum distance and elevation of any runway. Once a correction factor is determined, it is applied to non-standard altitude until the aircraft lands. VFOM of radio altitude calibrated altitude is based on the accuracy of the calibration as estimated from the resolution of the terrain data and flatness of the terrain. The altitude is recalibrated if a correction with higher estimates accuracy is computed.

Barometric corrected altitude is calculated by a shift of the pressure altitude to a value corresponding to the entered baro correction.

A VFOM for corrected barometric altitude is computed in order to determine its weight in the final altitude. VFOM of corrected barometric altitude is estimated from height above the nearest runway aircraft altitude. Corrected barometric is not used in the Geometric Altitude solution above 18,000 ft when GPS altitude is valid or during take-off when runway calibrated altitude is available.

3 Blending and reasonableness checking

The final Geometric Altitude is computed by combining each of the valid component altitudes (GPS calibrated altitude, Radio altitude calibrated altitude, runway calibrated altitude and corrected barometric altitude). The weighting of each altitude is inversely proportional to the corresponding estimated VFOM. The blending algorithm gives the most weight to altitudes with a higher estimated accuracy (minimum VFOM), reducing the effect of less accurate altitudes on the final computed altitude.

Each component altitude is also checked for reasonableness using a window monitor computed from GPS altitude and GPS VFOM. Altitudes that are invalid, not available, or fall outside the reasonableness window are not included in the final blended altitude.

(3)Terrain Clearance Floor (TCF)

The Terrain Clearance Floor (TCF) alert function adds an additional element of protection to the standard Ground Proximity Warning System. It creates an increasing terrain clearance envelope around the airport runway to provide protection against Controlled Flight Into Terrain (CFIT) situations beyond that which is currently provided. TCF alerts are based on current aircraft location, nearest runway center point position and radio altitude. TCF is active during takeoff, cruise and final approach. This alert mode complements the existing Mode 4 protection by providing an alert based on insufficient terrain clearance even when in landing configuration. Alerts for TCF illuminate GPWS cockpit lamps and produce aural messages.

(a)System inputs

The following table lists the inputs required to allow implementation of the TCF function :

Input	Source
Radio Altitude	External : Radio Altimeter
Latitude	External : FMS
Longitude	External : FMS
Runway Center Latitude	Internal : Database
Runway Center Longitude	Internal : Database
Navigation mode	FMS
Alert Envelope Parameters	Internal : Database
1/2 Runway Length	Internal : Database
System Error Factor	Internal : Database

(b)Runway Database

The TCF Runway Database consists of data records containing the position of airport runway center points along with 1/2 the runway length. The database includes all hard surface runways in the world greater than or equal to 3500 ft. in length. The process of generating this database is certified and includes an end check that validates that the data was not corrupted in the translation process. This database can be updated without affecting the customer certified system part number.

The design of the database and related software is such that additional runway records can be added in the future without alterning the code. The database provides a means of accessing the Runway Record of the

runway closest to the current aircraft position.

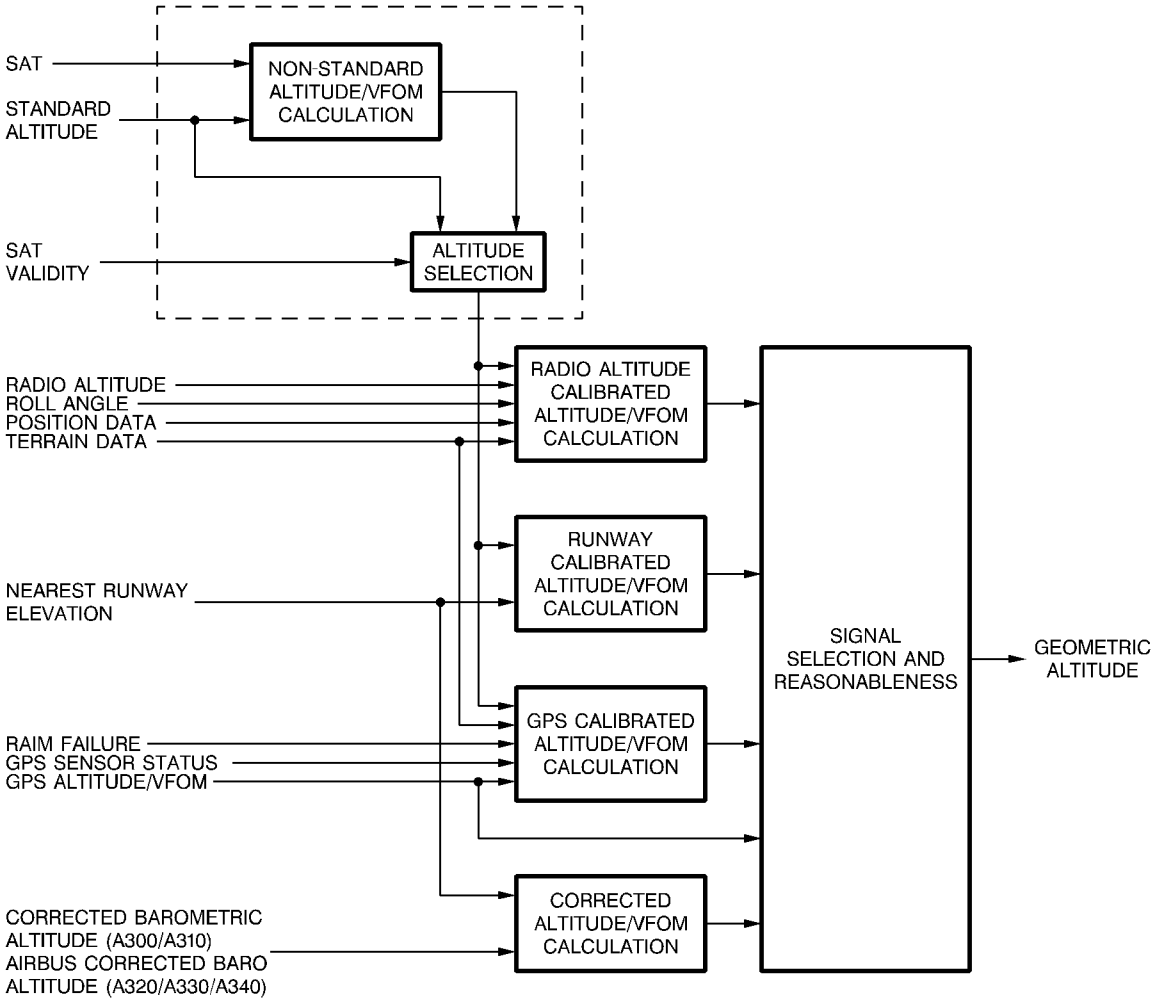
(c)Alert Envelope
The TCF alert envelope is a circular band centered over the nearest runway.
(Ref. Fig. 034)
The distance from the runway center to the inner envelope edge is equal to 1/2 the runway length plus the Envelope Bias Factor.
Thus the inner and outer radius of the envolope are modulated based on the runway length and Envelope Bias Factor. Runway length will vary from one runway to the next, and the Envelope Bias Factor is typically 1/2 NM to 2NM and varies with position accuracy.
The outer alert envelope boundary extends to infinity, or until it meets the outer alert envelope boundary of another runway. The alert will be inhibited below Radio Altitude of 30 ft.. This cutoff value was chosen to match the current mode 4 lower cutoff value.
The TCF curve is limited to a minimum value of 245 feet when it is determined that the aircraft is to the side of the runway. This feature provides improved alerting when landing to the side of the runway.
(Ref. Fig. 035)

(d)Runway Field Clearance Floor (RFCF)
(Ref. Fig. 036)
The runway field clearance floor alert envelope is a circular band centered over the selected runway. But unlike the radio altitude based on TCF envelope, the RFCF envelope only extends 5 NM past the end of the runway. The bias factor (where the protection starts) is equal to the TCF bias factor (k) plus an additional offset proportional to the geometric altitude figure of merit (FOM).
This feature provides improved alerting for cases where the runway is at a high elevation compared to the terrain below the approach path. In these cases the radio altitude may be large enough to inhibit normal TCF operation, but the aircraft could actually be below the runway elevation. Field clearance (height above runway) is determined by subtracting the elevation of the selected destination runway from the current altitude (MSL).

(e)System Outputs
When an aircraft penetrates the TCF alert envelope the following aural message will occur : "TOO LOW TERRAIN".
This aural message will occur once when initial envelope penetration occurs, and one time thereafter for each 20 per cent degradation in Radio Altitude. At the same time the GPWS legend of the PULL UP/GPWS indicator lights comes on. The legends remain on until the alert envelope is exited.

**ON A/C 101-200,

Post SB 34-2205 For A/C 101-200,



BM5 34 48 00 0 ABP0 00

EGPWS - Additional Logic
Figure 033

Post SB 34-2207 For A/C 101-200,

**ON A/C 101-200,

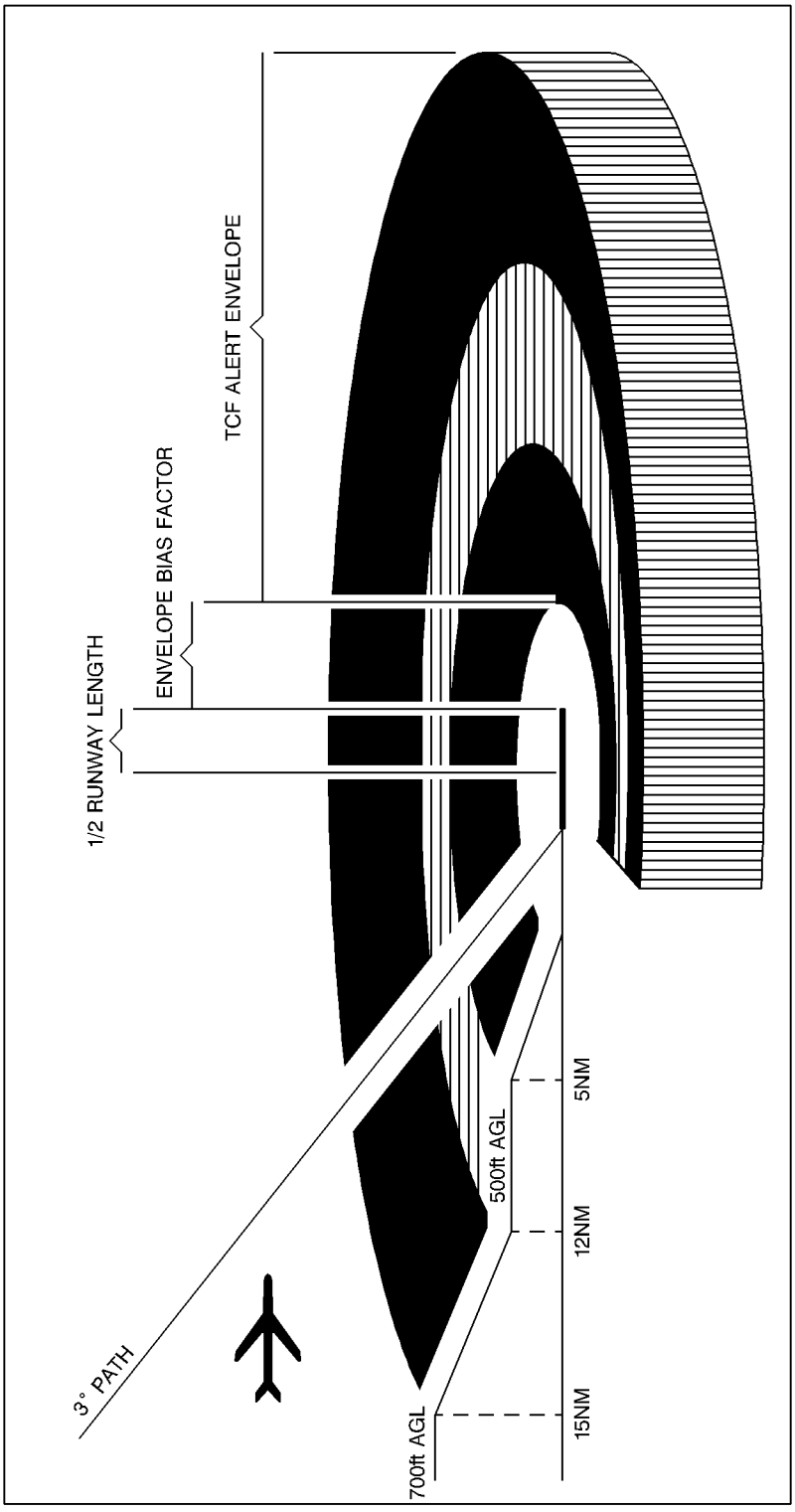
**ON A/C 101-200,

Post SB 34-2205 For A/C 101-200,

Post SB 34-2207 For A/C 101-200,

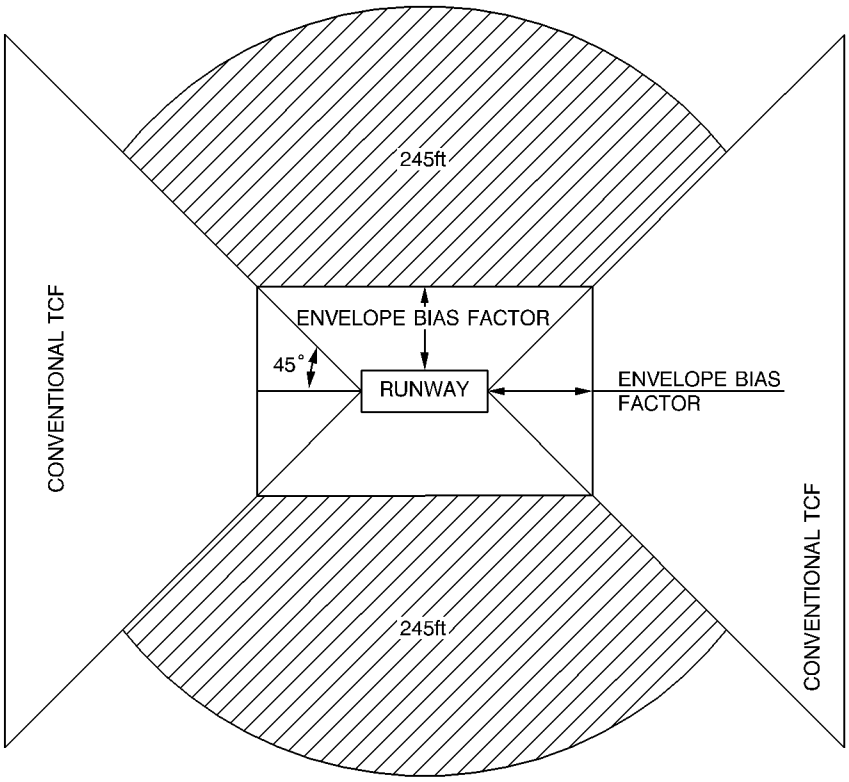
**ON A/C 101-200,

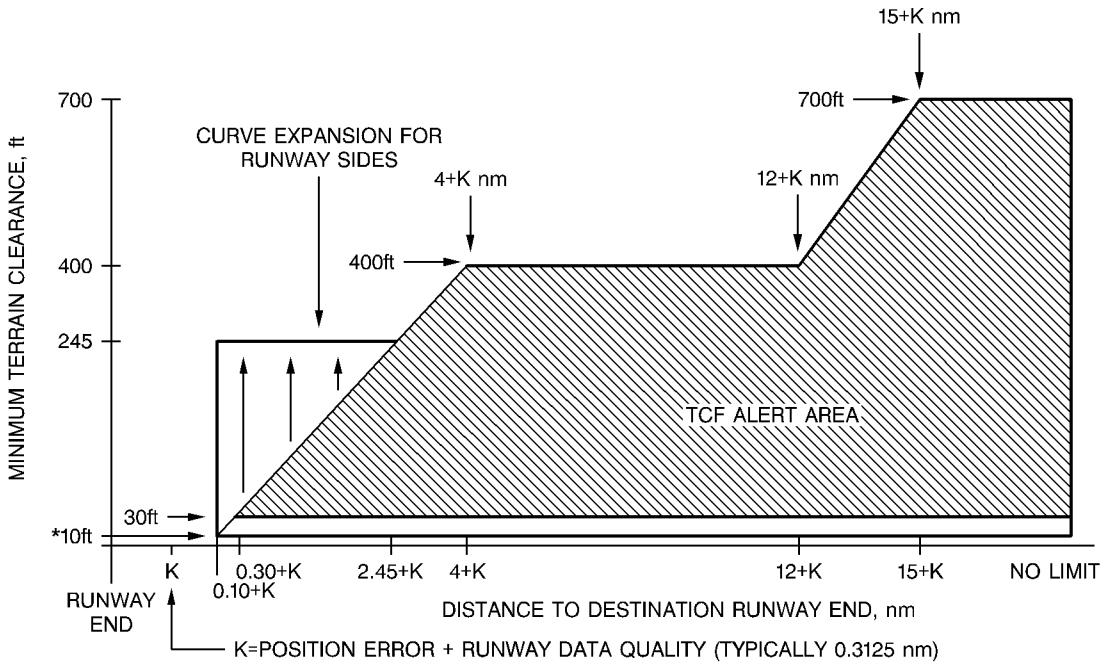
Post SB 34-2205 For A/C 101-200,



BM5 34 48 00 0 AAV0 00

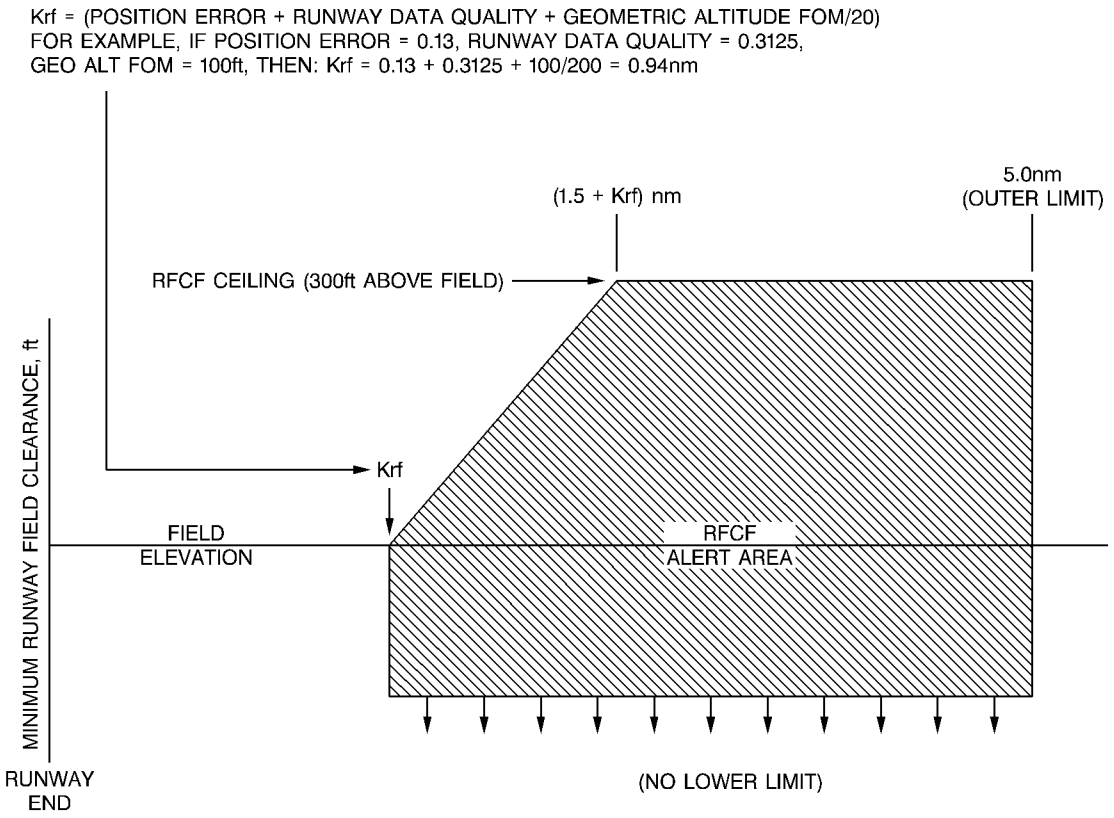
EGPWS - TCF Alert Envelope
Figure 034





BM5 34 48 00 0 ABQ0 00

EGPWS - TCF Curve Limit
Figure 035


Krf = (POSITION ERROR + RUNWAY DATA QUALITY + GEOMETRIC ALTITUDE FOM/20)
FOR EXAMPLE, IF POSITION ERROR = 0.13, RUNWAY DATA QUALITY = 0.3125,
GEO ALT FOM = 100ft, THEN: Krf = 0.13 + 0.3125 + 100/200 = 0.94nm
(1.5 + Krf) nm
5.0nm
(OUTER LIMIT)
RFCF CEILING (300ft ABOVE FIELD)
MINIMUM RUNWAY FIELD CLEARANCE, ft
Krf
FIELD
ELEVATION
RFCF
ALERT AREA
RUNWAY
END
(NO LOWER LIMIT)

BM5 34 48 00 0 ABR0 00

EGPWS - Shape of the Alert Envelope
Figure 036

**ON A/C 101-104,

E. Warning Generation and Inhibition

(1)Audio Output
Alert outputs result in an audio voice warning unless inputs are invalid or one of the audio suppression discretes is active. The actual output message, or intended message during audio suppression, is sent to the warning lamp logic for proper output activation.
The audio outputs consist of a transformer isolated 600 Ohm output.
Aural warnings and their priority rate are as follows :

RELATIVE PRIORITY	WARNING CONDITION	POSSIBLE MESSAGES	LEGEND
HIGHEST	Mode 1 Pull Up	Pull Up	GPWS
	Mode 2 Pull Up	Pull Up	GPWS
	Mode 2 Pull Up Preface	Terrain Terrain	GPWS
	Terrain Awareness Preface	Terrain Ahead	GPWS
	Terrain Awareness Pull-Up	Terrain Ahead Pull-Up	GPWS
	Mode 2 Terrain	Terrain	GPWS
*	Terrain Awareness Caution	Terrain Ahead	GPWS
*	Mode 4 Too Low Terrain	Too Low Terrain	GPWS
	TCF Too Low Terrain	Too Low Terrain	GPWS
*	Mode 4 Too Low Gear	Too Low Gear	GPWS
*	Mode 4 Too Low Flaps	Too Low Flaps	GPWS
*	Mode 1 Sinkrate	Sinkrate	GPWS
*	Mode 3 Don't Sink	Don't Sink	GPWS
LOWEST *	Mode 5 Glideslope	Glideslope	G/S

* Allows interleaving of multiple alerts.

The voice warning circuits also contain logic elements which ensure that :
- only one message at a time is output,
- higher priority messages interrupt lower priority messages except if interleaving is allowed (see previous table),
- a triggered message is completed even when warning condition ceases,
- a 0.75 s pause exists between warning messages.

(2)Alert discrete outputs

Mode 5 "GLIDESLOPE" message activates the alert lamp output (which illuminates G/S amber legend).

All other messages activate the warning lamp output (which illuminates GPWS red legend).

(3)Inhibitions

(a)All audio inhibition :

(Ref. Fig. 008)

The "inhibit all audio" discrete input controls the audio outputs as follows. When grounded, all voices are inhibited (not interrupted, all audio message once started are finished). Visual and display indications are not affected. This input is used to manage the audio priority with other systems (FWS, PWS, TCAS).

(b)Modes 1 to 5 inhibitions

The "inhibit modes 1 to 5" discrete input controls the audio and visual outputs as follows. When grounded, this input always inhibits all GPWS audio and visual indications with the exception of Terrain Clearance Floor Alerts and Terrain Awareness caution and warnings. This input is wired to NORM/FLAP OVRD/OFF switch to manually inhibit GPWS modes 1 to 5 (switch on OFF position).

(c)TAD and TCF inhibitions

- The "Terrain awareness inhibit" discrete input controls the audio, visual and display outputs as follows. When grounded, this input always inhibits TAD and TCF audio, visual and display indications. This input is wired to "TERR MODE" pushbutton switch to manually inhibit TAD and TCF functions.
- TAD and TCF functions may also be inhibited automatically when the FMS aircraft position accuracy is not accurate enough. This is indicated to the crew by the automatic deselection of terrain display and the illumination of the STBY legend of the TERR pushbutton switches 30WZ1 and 30WZ2.

F. EGPWC Maintenance Output

A maintenance output signal (label 270 octal) is provided by the ARINC 429 transmitter. The transmitter converts the microprocessor parallel data to standard serial data for the DMU of the AIDS.

R **ON A/C 101-200,

R Post SB 34-2188 For A/C 101-200,

R Post SB 34-2206 For A/C 101-200,

R E. Warning Generation and Inhibition

R (1)Audio Output
R Alert outputs result in an audio voice warning unless inputs are invalid
R or one of the audio suppression discretes is active. The actual output
R message, or intended message during audio suppression, is sent to the
R warning lamp logic for proper output activation.
R The audio outputs consist of a transformer isolated 600 Ohm output.
R Aural warnings and their priority rate are as follows :

RELATIVE PRIORITY	WARNING CONDITION	POSSIBLE MESSAGES	LEGEND
HIGHEST	Mode 1 Pull Up	Pull Up	PULL UP
	Mode 2 Pull Up	Pull Up	PULL UP
	Mode 2 Pull Up Preface	Terrain Terrain	GPWS
	Terrain Awareness Preface	Terrain Ahead	GPWS
	Terrain Awareness Pull-Up	Terrain Ahead Pull-Up	PULL UP
	Mode 2 Terrain	Terrain	GPWS
*	Terrain Awareness Caution	Terrain Ahead	GPWS
*	Mode 4 Too Low Terrain	Too Low Terrain	GPWS
	TCF Too Low Terrain	Too Low Terrain	GPWS
*	Mode 4 Too Low Gear	Too Low Gear	GPWS
*	Mode 4 Too Low Flaps	Too Low Flaps	GPWS
*	Mode 1 Sinkrate	Sinkrate	GPWS
*	Mode 3 Don't Sink	Don't Sink	GPWS
LOWEST *	Mode 5 Glideslope	Glideslope	GPWS

R * Allows interleaving of multiple alerts.

R The voice warning circuits also contain logic elements which ensure
R that :
R - only one message at a time is output,
R - higher priority messages interrupt lower priority messages except if
R interleaving is allowed (see previous table),
R - a triggered message is completed even when warning condition ceases,
R - a 0.75 s pause exists between warning messages.

R (2)Alert discrete outputs
R Mode 1, 2 and TAD "PULL UP" message activates the warning lamp output
R (which illuminates PULL UP red legend).
R All other messages activate the alert warning lamp output (which
R illuminates GPWS amber legend).

R (3)Inhibitions

R (a)All audio inhibition :
R (Ref. Fig. 009)

R The "inhibit all audio" discrete input controls the audio outputs as
R follows. When grounded, all voices are inhibited (not interrupted, all
R audio message once started are finished). Visual and display
R indications are not affected. This input is used to manage the audio
R priority with other systems (FWS, PWS, TCAS).

R (b)Modes 1 to 5 inhibitions

R The "inhibit modes 1 to 5" discrete input controls the audio and visual
R outputs as follows. When grounded, this input always inhibits all GPWS
R audio and visual indications with the exception of Terrain Clearance
R Floor Alerts and Terrain Awareness caution and warnings. This input
R is wired to NORM/FLAP OVRD/OFF switch to manually inhibit GPWS modes
R 1 to 5 (switch on OFF position).

R (c)TAD and TCF inhibitions

R - The "Terrain awareness inhibit" discrete input controls the audio,
R visual and display outputs as follows. When grounded, this input
R always inhibits TAD and TCF audio, visual and display indications.
R This input is wired to "TERR MODE" pushbutton switch to manually
R inhibit TAD and TCF functions.
R - TAD and TCF functions may also be inhibited automatically when the
R FMS aircraft position accuracy is not accurate enough. This is
R indicated to the crew by the automatic deselection of terrain display
R and the illumination of the STBY legend of the TERR pushbutton
R switches 30WZ1 and 30WZ2.

R F. EGPWC Maintenance Output
R A maintenance output signal (label 270 octal) is provided by the ARINC 429

R transmitter. The transmitter converts the microprocessor parallel data to
R standard serial data for the DMU of the AIDS.

**ON A/C 101-104,

7. Test

A. Self-Tests

(1)On the ground only, the EGPWC provides self-test capability, providing an indication of the ability of the EGPWC to perform its intented function.

(2)The EGPWC self-test is initiated by momentarily pressing GPWS/G/S indicator lights. When activated by pressing the GPWS/G/S indicator lights, the self-test is enunciated, via the same audio system as the EGPWS alerts. This selt-test can also be accessed via the headphone jack on the front panel of the EGPWC and it has been divided into six different levels to help with EGPWC testing and troubleshooting.

(a)Level 1
Level 1, functional testing, provides an overview of the current operational functions selected and provides an indication of their operational status.
A long level 1 self-test sequence is initiated when the GPWS/G/S indicator light is not released while self-test voices start.
Level 1 Self-Test Sequence :
- FAULT legends of the TERR MODE pushbutton switch and GPWS annunciator come on,
- G/S legends of both GPWS/G/S indicator lights come on,
- "GLIDESLOPE" audio phase is broadcasted,
- G/S legends of both GPWS/G/S indicator lights go off,
- GPWS legends of both GPWS/G/S indicator lights come on,
- "PULL UP" audio phase is broadcasted,
- "TERRAIN AHEAD PULL UP" audio phase is broadcasted,
- ON ND legends of both TERR pushbutton switches come on,
- terrain self-test pattern is displayed on both NDs, (Ref. Fig. 037)
- vocabulary sequence when long self-test initiated :

"SINK RATE"
"PULL UP"
"TERRAIN"
"PULL UP"
"DON'T SINK"
"DON'T SINK"
"TOO LOW TERRAIN"
"TOO LOW GEAR"
"TOO LOW FLAPS"
"TOO LOW TERRAIN"
"GLIDESLOPE"
"TOO LOO TERRAIN"
"TERRAIN AHEAD"

"TERRAIN AHEAD"
"TERRAIN AHEAD PULL UP"

- terrain self-test pattern turns off,
- ON ND legends of both TERR pushbutton switches and the images displayed on both ND's revert to the configuration selected before the test,
- the FAULT legends of the TERR MODE pushbutton switch and GPWS annunciator go off.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

7. Test

A. Self-Tests

(1)On the ground only, the EGPWC provides self-test capability, providing an indication of the ability of the EGPWC to perform its intented function.

(2)The EGPWC self-test is initiated by momentarily pressing PULL UP/GPWS indicator lights. When activated by pressing the PULL UP/GPWS indicator lights, the self-test is enunciated, via the same audio system as the EGPWS alerts. This selt-test can also be accessed via the headphone jack on the front panel of the EGPWC and it has been divided into six different levels to help with EGPWC testing and troubleshooting.

(a)Level 1
Level 1, functional testing, provides an overview of the current operational functions selected and provides an indication of their operational status.
A long level 1 self-test sequence is initiated when the PULL UP/GPWS indicator light is not released while self-test voices start.
Level 1 Self-Test Sequence :
- FAULT legends of the TERR MODE pushbutton switch and GPWS annunciator come on,
- GPWS legends of both PULL UP/GPWS indicator lights come on,
- "GLIDESLOPE" audio phase is broadcast,
- GPWS legends of both PULL UP/GPWS indicator lights go off,
- PULL UP legends of both PULL UP/GPWS indicator lights come on,
- "PULL UP" audio phase is broadcast,
- "TERRAIN AHEAD PULL UP" audio phase is broadcast,
- ON ND legends of both TERR pushbutton switches come on,
- terrain self-test pattern is displayed on both NDs, (Ref. Fig. 038)
- vocabulary sequence when long self-test initiated :

"SINK RATE"
"PULL UP"
"TERRAIN"
"PULL UP"
"DON'T SINK"
"DON'T SINK"
"TOO LOW TERRAIN"
"TOO LOW GEAR"
"TOO LOW FLAPS"
"TOO LOW TERRAIN"
"GLIDESLOPE"
"TOO LOW TERRAIN"
"TERRAIN AHEAD"
"TERRAIN AHEAD"
"TERRAIN AHEAD PULL UP"
"OBSTACLE AHEAD"
"OBSTACLE AHEAD"
"OBSTACLE AHEAD PULL UP"

- terrain self-test pattern turns off,
- **ON ND** legends of both **TERR** pushbutton switches and the images displayed on both **ND**s revert to the configuration selected before the test,
- the **FAULT** legends of the **TERR MODE** pushbutton switch and **GPWS** annunciator go off.

If the Peaks display option is selected, then the Peaks elevations are provided to the displays as follows:
XXX (amber)
XXX (amber)
for 5 seconds then:
290 (Red) High altitude
-13 (Green) Low altitude

**ON A/C 101-200,

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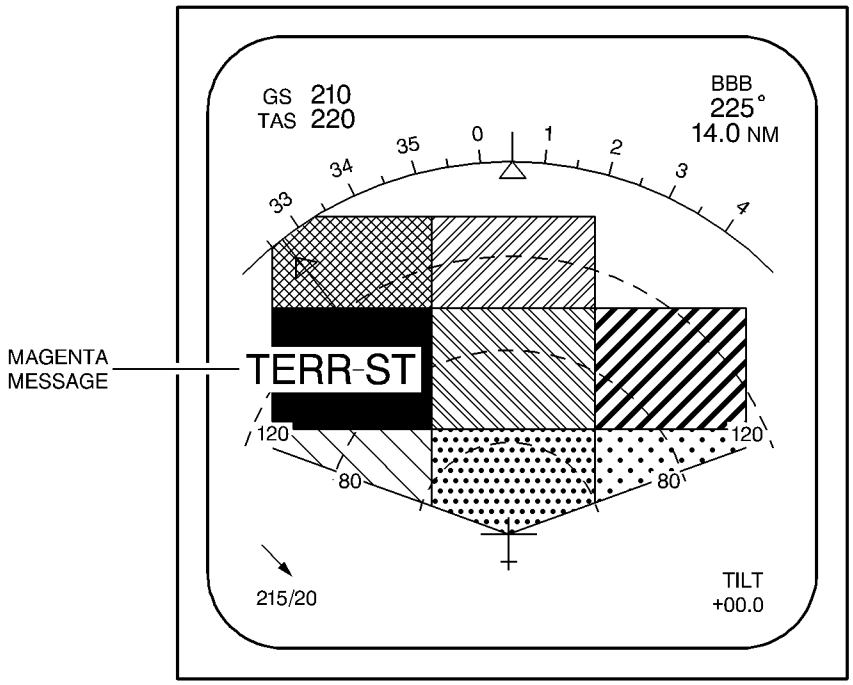
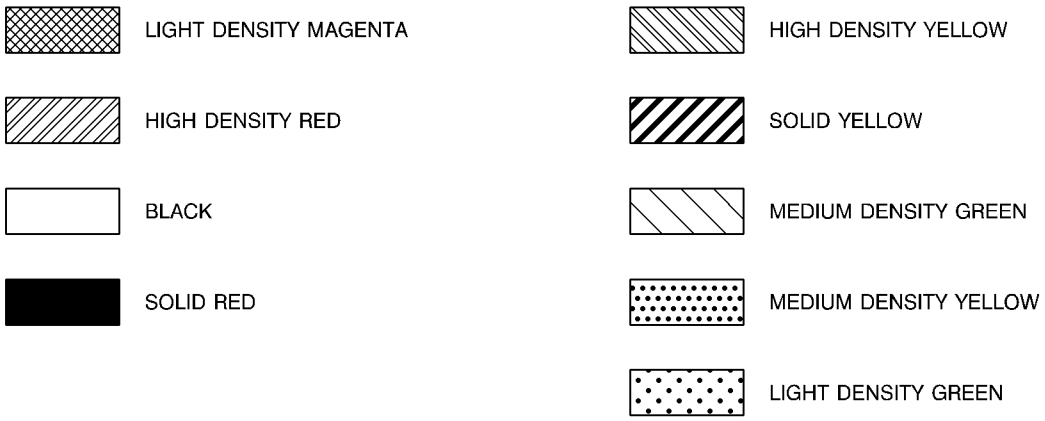
**ON A/C 101-104,

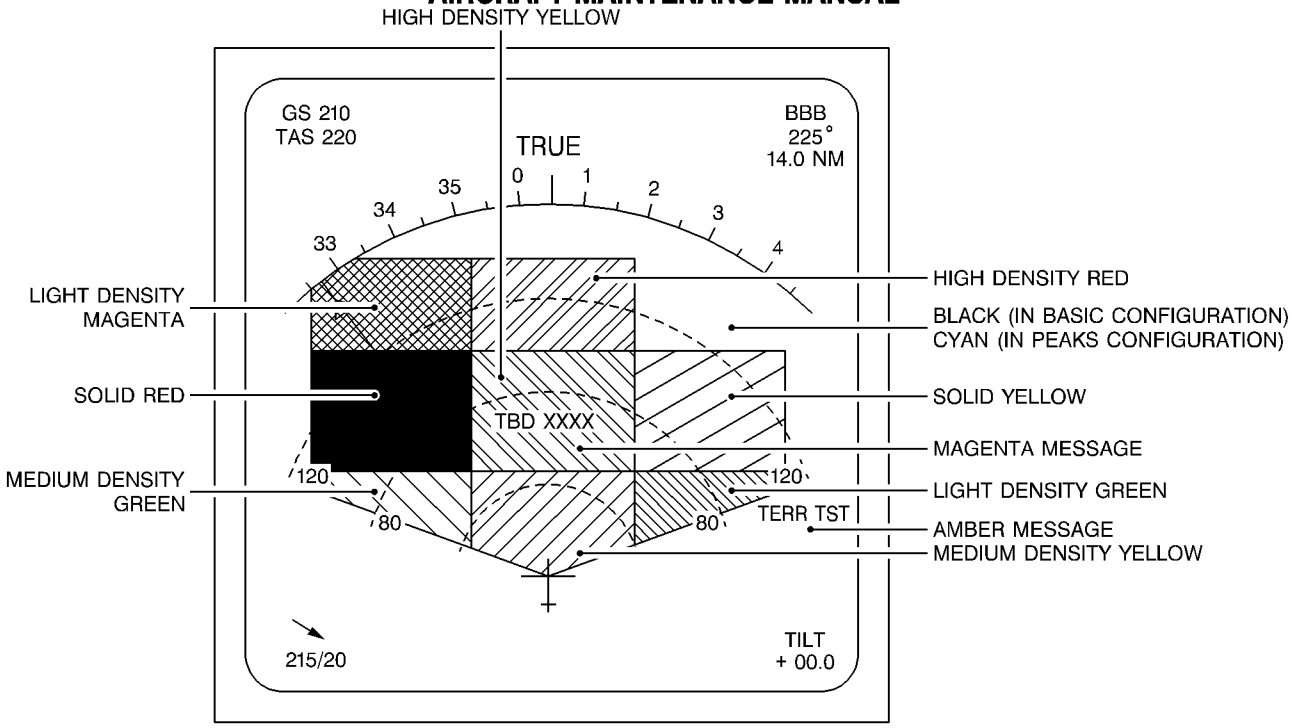
(b)Level 2





BM5 34 48 00 0 AAW0 00

EGPWS - Test Pattern
Figure 037



BM5 34 48 00 0 EDM0 00

EGPWS - Test Pattern
Figure 038

Level 2 current faults, provides a listing of the internal and external faults currently detected by the EGPWC.
Level 2 self-test is initiated by pressing the GPWS/G/S indicator light within 3 seconds after the end of level 1 self-test.

(c)Level 3
Level 3, EGPWS configuration, indicates the current configuration by listing the current hardware, software, databases and program pin inputs detected by the EGPWC.
This level is initiated by pressing the GPWS/G/S indicator light when "PRESS TO CONTINUE" phrase is enunciated.

(d)Level 4
Level 4, fault history, provides a historical record of both internal and external faults detected by the EGPWC.
This level is initiated by pressing the GPWS/G/S indicator light when "PRESS TO CONTINUE" phrase is enunciated.

(e)Level 5
Level 5, warning history, provides a historical record of the warnings and cautions given by the EGPWC.
This level is initiated by pressing the GPWS/G/S indicator light when "PRESS TO CONTINUE" phrase is enunciated.

(f)Level 6
Level 6, discrete test, provides annunciation of discrete input transitions to be used for maintenance support.
This level is initiated by pressing the GPWS/G/S indicator light when "PRESS TO CONTINUE" phrase is enunciated.

(3)To expedite the navigation of self-test levels and information two types of cancel sequences are supported. Pressing and holding the GPWS/G/S indicator light for less than 2 seconds is considered to be a Short Cancel. Pressing and holding the GPWS/G/S indicator light for more than 2 seconds is considered to be a Long Cancel.

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(b)Level 2
Level 2 current faults, provides a listing of the internal and external faults currently detected by the EGPWC.
Level 2 self-test is initiated by pressing the PULL UP/GPWS pushbutton switch within 3 seconds after the end of level 1 self-test.

(c)Level 3
Level 3, EGPWS configuration, indicates the current configuration by listing the current hardware, software, databases and program pin

inputs detected by the **EGPWC.**
This level is initiated by pressing the **PULL UP/GPWS** pushbutton switch when **"PRESS TO CONTINUE"** phrase is enunciated.

(d)Level 4
Level 4, fault history, provides a historical record of both internal and external faults detected by the **EGPWC.**
This level is initiated by pressing the **PULL UP/GPWS** pushbutton switch when **"PRESS TO CONTINUE"** phrase is enunciated.

(e)Level 5
Level 5, warning history, provides a historical record of the warnings

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ENHANCED GROUND PROXIMITY WARNING SYSTEM - SERVICING

R **ON A/C 101-200,

R Post SB 34-2188 For A/C 101-200,

R Post SB 34-2206 For A/C 101-200,

R 1. Uploading of PCMCIA Card Database

R A. Reason for the Job
R To upload the PCMCIA card database in the Enhanced Ground Proximity
R Warning Computer (EGPWC).

R B. Referenced Procedures

ITEM	DESIGNATION
A.	Access Platform, 3.00 m (10 ft.)
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-48-00, P. Block 501	Enhanced Ground Proximity Warning System

R C. Procedure
R (1)Job set-up
R (a)Connect the eletrical ground power unit and energize the aircraft
R electrical network (Ref. 24-41-00, P. Block 301).
R (b)Make certain that electronics racks ventilation is correct.
R (c)Close overhead panel circuit breakers.
R (d)Close L/G GEAR PROX DET and RELAYS - SYS1 and L/G GEAR PROX
R DET and RELAYS - SYS2 circuit breakers on panel 133VU (aircraft in
R ground configuration).
R (e)Close the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/GPWS - CMPTR	6WZ	108/B11
21VU	NAVIGATION/GPWS - WARN	7WZ	108/B12

R (f)Put access platform in position and open access door 121BL to gain
R access to avionics compartment.
R (2)Uploading procedure

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(Ref. Fig. 301)

**ON A/C 101-200,

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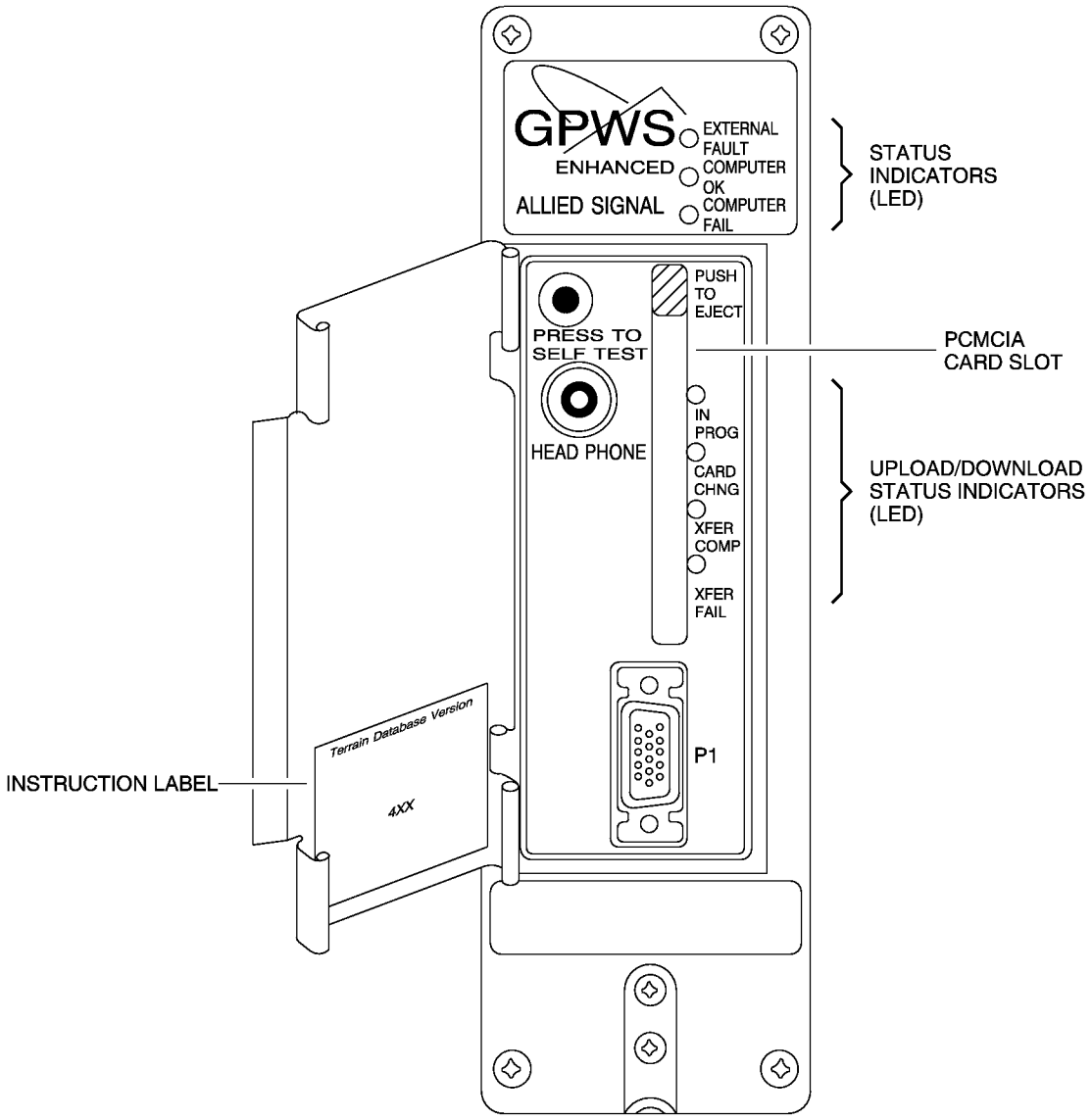
(a)In avionics compartment, in left electronics rack 80VU (shelf 86VU), open the door on the face of the EGPWC.
(b)Make certain that:
- COMPUTER OK LED is on
- IN PROG LED is off
- CARD CHNG LED is off
- XFER COMP LED is off
- XFER FAIL LED is off

CAUTION : WHEN YOU INSERT THE CARD, DO NOT APPLY TOO MUCH FORCE ON IT AT END OF TRAVEL. IF YOU DO, THIS WILL DAMAGE THE INTERNAL CONNECTOR OF THE EGPWC.

(c)Put the PCMCIA card in the PCMCIA card slot with the notch on the card positioned downwards.
(d)Carefully push the card into the slot until the PUSH TO EJECT button on the face of the EGPWC is fully released (out).
NOTE : This button reaches the fully released position when its face is nearly on a level with the rear of the inserted card.

(e)During uploading, make certain that the IN PROG LED stays on and the COMPUTER OK LED is off.
(f)When uploading is completed, make certain that the XFER COMP LED



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Enhanced Ground Proximity Warning Computer (EGPWC)

R Figure 301

comes on.

(g) Eject the PCMCIA card by pressing the PUSH TO EJECT button then remove the card.

(h) After approximately 30 seconds, make certain that the COMPUTER OK LED comes on.

(j) Close the door on the face of the EGPWC.

D. Test

Do the operational test of the EGPWC (Ref. AMM 34-48-00, P. Block 501).

E. Close-Up

(1) Make certain that the work area is clean and clear of tools and other items.

(2) Close access door 121BL and remove access platform.

(3) De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. AMM 24-41-00, P. Block 301).

1. Operational Test

A. Reason for the Job
BITE test and check of input interfaces (except: flaps > 32 deg. input)

B. Referenced Procedures

- 24-41-00, P. Block 301 AC External Power Control
- 34-10-00, P. Block 501 Air Data Computer (ADC)
- 34-25-00, P. Block 501 Inertial Reference System (IRS)
- 34-36-00, P. Block 501 ILS Receiver
- 34-42-00, P. Block 501 Radio Altimeter (RA1)

C. Procedure
(Ref. Fig. 501)

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Check that ADC1 is energized (Ref. 34-10-00, P. Block 501).
(d)Energize IRS1 by placing MSU1 mode selector switch in NAV position (Ref. 34-25-00, P. Block 501).
(e)Check that ILS1 is energized (Ref. 34-36-00, P. Block 501).
(f)Check that RA1 is energized (Ref. 34-42-00, P. Block 501).
(g)Make certain that the LDG GEAR/POSITION DET/SYS1/SYS2 switch (10GA) is in the SYS2 position.
(h)Make certain that GPWS NORM/FLAP OVRD/OFF switch (12WZ) is in NORM position and guarded.

CAUTION : BEFORE THE TEST OF THE GPWS, MAKE SURE THAT THE BAROMETRIC CORRECTION ON THE ALTIMETER IS SET BETWEEN 22 AND 31 IN HG. IF NOT IN THIS RANGE, THE BAROMETRIC ALTITUDE IS NOT SEEN AS A VALID DATA AND THE TEST IS NOT POSSIBLE.

(j)Make certain that the following circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION GPWS/CMPTR	6WZ	108/B11
21VU	NAVIGATION GPWS/WARN	7WZ	108/B12
133VU	HYDRAULIC/L/G PROX DET/RELAYS SYS 1 AND RETRACT CTL	2GB	332/U51
133VU	HYDRAULIC/L/G PROX DET AND RELAYS SYS 1 FLT/GND	119GB	332/U52
133VU	HYDRAULIC/L/G PROX DET/RELAYS SYS 1 GEAR DOWN/CTR PNL POS IND	3GB	333/U53
133VU	HYDRAULIC/L/G PROX DET/RELAYS SYS 2 GEAR DOWN/OVHD PNL POS IND	83GB	331/V51
133VU	HYDRAULIC/L/G PROX DET AND RELAYS SYS 2 FLT/GND	1GB	331/V52

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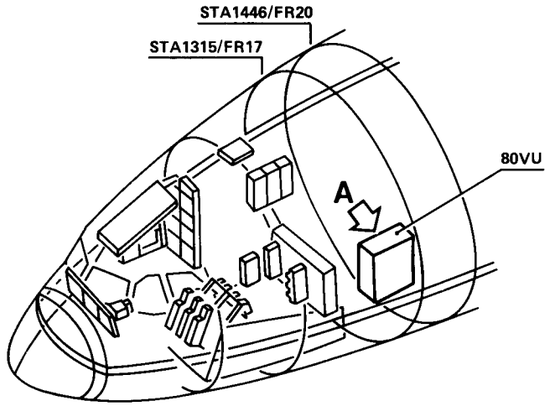

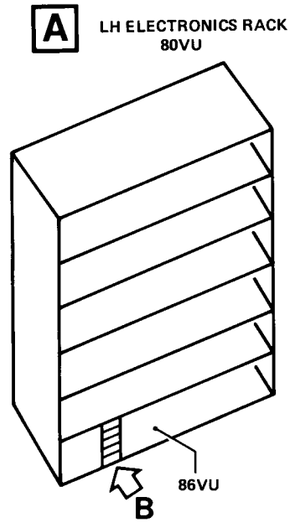

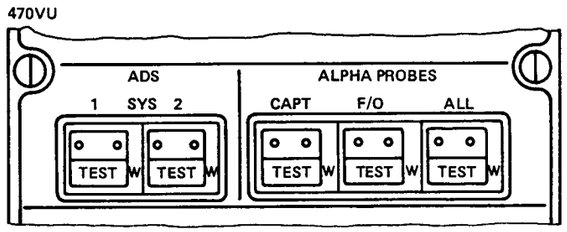

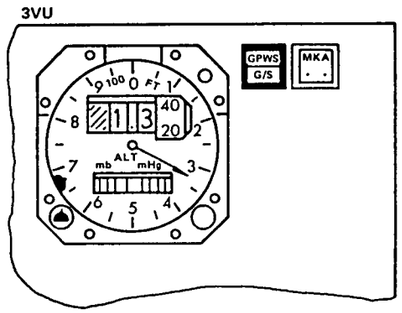

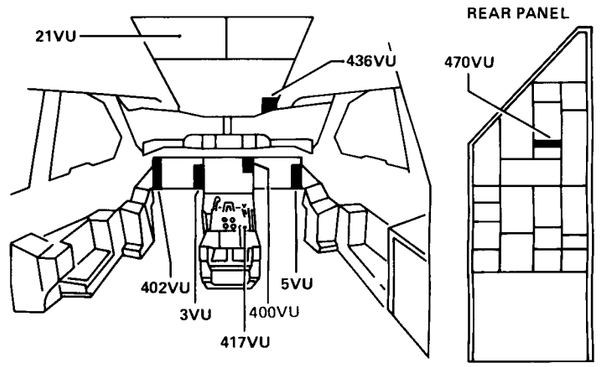

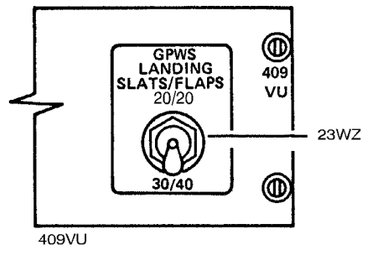

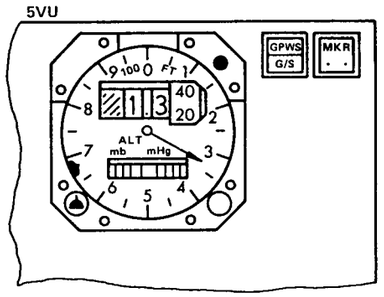

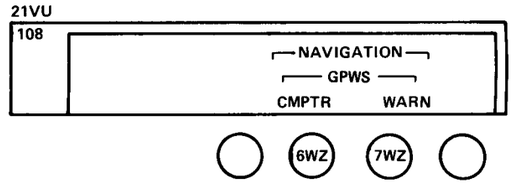

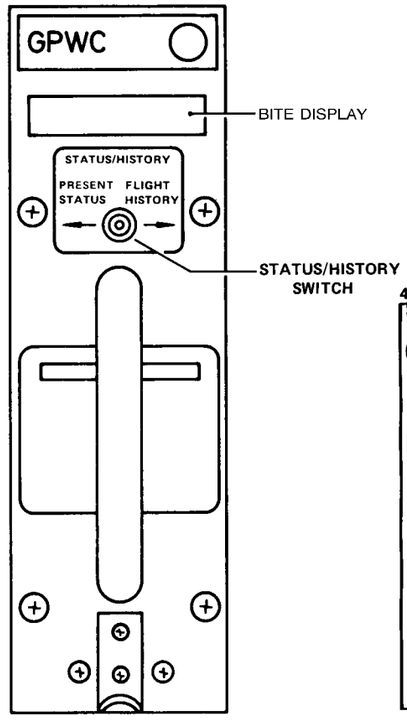

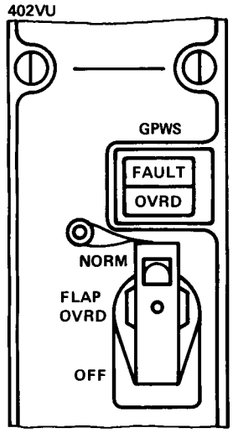

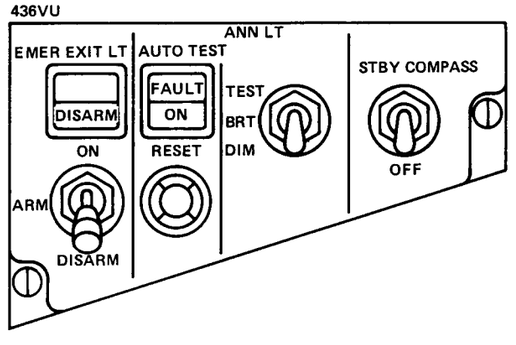

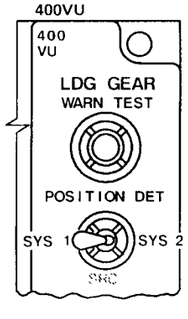

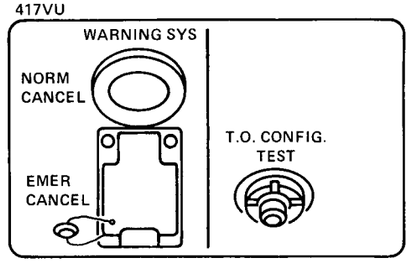

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GPWS Test Switches
Figure 501

R EFFECTIVITY: 001-100,

PIA

(2)Test of Input Interfaces

CAUTION : WHEN ALPHA PROBE TEST IS SELECTED ON PANEL 470VU, THE PROBE ASSOCIATED WITH THE PUSHBUTTON OPERATED IS DRIVEN TO AN ANGLE EQUIVALENT TO +30° ANGLE OF ATTACK. BEFORE MAKING A "TEST" SELECTION, MAKE CERTAIN THAT THE PROBES ARE NOT OBSTRUCTED.

R **ON A/C 001-004,

ACTION	RESULT
1. On panel 436VU - Place ANN LT/TEST/BRT/DIM switch in TEST position.	In the flight compartment - A number of warning signals comes on which are not valid for the ground proximity warning system. On panel 402VU - The FAULT and OVRD legends of the GPWS annunciator (24WZ) come on. On panels 3VU and 5VU - The GPWS and the G/S legends of the indicator lights (3WZ and 4WZ) come on.
2. On panel 436VU - Place ANN LT/TEST/BRT/DIM switch in DIM or BRT position.	On panel 402VU - The FAULT and OVRD legends of the GPWS annunciator (24WZ) go off. On panels 3VU and 5VU - The GPWS and G/S legends of the indicator lights (3WZ and 4WZ) go off. In the flight compartment - The other warning signals go off.
3. In the avionics compartment, in the electronics rack 86VU, on the GPWC front panel - Press the STATUS/HISTORY switch to the PRESENT STATUS position, hold for 1 s minimum, and release.	In the avionics compartment, on the GPWC front panel BITE display - An all-segment test runs. - GPWS OK is indicated (or any other present status). - END TEST is indicated.
4. On panel 417VU - Break the copper wire, lift the safety cover and press the WARNING SYS/EMER CANCEL switch to the EMER CANCEL position for more than 45 s.	On panel 402VU - The FAULT legend of the GPWS annunciator (24WZ) comes on.
5. On panel 417VU	On panel 402VU

ACTION	RESULT
- Release the **WARNING SYS/EMER CANCEL** switch.	- The **FAULT** legend of the **GPWS** annunciator (24WZ) goes off.
6. On maintenance panel 470VU	On maintenance panel 470VU, on the **ALPHA PROBES/CAPT** pushbutton switch
- Press the **ALPHA PROBES/CAPT** pushbutton switch for more than 60 seconds.	- The **TEST** light comes on. On the captain's and first officer's control columns - The stick shaker is activated and the **CRICKET** aural warning sounds. On panel 402VU - The **FAULT** legend of the **GPWS** annunciator (24WZ) comes on within a period of 60 seconds.
7. On maintenance panel 470VU - Release the **ALPHA PROBES/CAPT** pushbutton switch.	On maintenance panel 470VU - The **TEST** light goes off. On the captain's and first officer's control columns - The stick shaker stops and the **CRICKET** aural warning stops. On panel 402VU - The **FAULT** legend of the **GPWS** annunciator (24WZ) goes off.
8. On panel 133VU - Open the circuit breaker **HYDRAULIC/ L/G GEAR PROX DET AND SYS2/GEAR DOWN AND OVHD PNL POS IND (83GB),** location V51.	The repetitive chime sounds. On panel 402VU - The **FAULT** legend of the **GPWS** annunciator (24WZ) comes on.
9. On panel 133VU - Close the circuit breaker **HYDRAULIC/ PROX DET AND RELAYS SYS2/GEAR DOWN AND OVHD PNL POS IND (83GB),** location V51.	The chime stops. On panel 402VU - The **FAULT** legend of the **GPWS** annunciator (24WZ) goes off.

**ON A/C 005-100,

ACTION	RESULT
1. On panel 436VU - Place ANN LT/TEST/BRT/DIM switch in TEST position.	In the flight compartment - A number of warning signals comes on which are not valid for the ground proximity warning system. On panel 402VU - The FAULT and OVRD legends of the GPWS annunciator (24WZ) come on. On panels 3VU and 5VU - The GPWS and G/S legends of the indicator lights (3WZ and 4WZ) come on.
2. On panel 436VU - Place ANN LT/TEST/BRT/DIM switch in DIM or BRT position.	On panel 402VU - The FAULT and OVRD legends of the GPWS annunciator (24WZ) go off. On panels 3VU and 5VU - The GPWS and G/S legends of the indicator lights (3WZ and 4WZ) go off. In the flight compartment - The other warning signals go off.
3. In the avionics compartment, in the electronics rack 86VU, on the GPWC front panel - Press the STATUS/HISTORY switch to the PRESENT STATUS position, hold for 1 s minimum, and release.	In the avionics compartment, on the GPWC front panel BITE display, the following indications scroll - All segments of all indicator digits come on - IN TEST - AIRCRAFT TYPE x, (x is a substitute for a number) - List of selected options (e.g., ALT MODE 4 SELECTED.) - SYSTEM OK - SOFTWARE VERSION IS yyyyyyy, (y's are substitutes for a version code) - DATA BASE VERSION IS zzz, date, (z's are substitutes for a version code) - END TEST
4. On panel 417VU - Break the copper wire, lift the safety cover and press the WARNING SYS/EMER CANCEL switch to	On panel 402VU - The FAULT legend of the GPWS annunciator (24WZ) comes on.

ACTION	RESULT
the EMER CANCEL position for more than 45 s.	
5. On panel 417VU - Release the WARNING SYS/EMER CANCEL switch.	On panel 402VU - The FAULT legend of the GPWS annunciator (24WZ) goes off.
6. On maintenance panel 470VU - Press the APLHA PROBES/CAPT pusbutton switch for more than 60 seconds.	On maintenance panel 470VU, on the ALPHA PROBES/CAPT pushbutton switch - The TEST light comes on. On the captain's and first officer's control columns - The stick shaker is activated and the CRICKET aural warning sounds. On panel 402VU - The FAULT legend of the GPWS annunciator (24WZ) comes on within a period of 60 seconds.
7. On maintenance panel 470VU - Release the ALPHA PROBES/CAPT pushbutton switch.	On maintenance panel 470VU - The TEST light goes off On the captain's and first officer's control columns - The stick shaker stops and the CRICKET aural warning stops. On panel 402VU - The FAULT legend of the GPWS annunciator (24WZ) goes off.

R **ON A/C 001-004,

(3)Cockpit Self Test

ACTION	RESULT
1. On panel 3VU or 5VU - Press CAPT or F/O GPWS/G/S indicator light momentarily, and release.	The following test sequence runs: On panel 402VU - The FAULT legend of the GPWS annunciator comes on. The internal BITE test runs for 1.5 s. On panels 3VU and 5VU

ACTION	RESULT
	- The G/S legend of the GPWS/G/S indicator lights comes on and the loudspeakers emit GLIDESLOPE. - The G/S legend of the GPWS/G/S indicator lights goes off. - The GPWS legend of the GPWS/G/S indicator lights comes on and the loudspeakers emit WHOOP-WHOOP PULL UP. - The GPWS legend of the GPWS/G/S indicator lights goes off. On panel 402VU - The FAULT legend of the GPWS annunciator goes off.
2. On panel 3VU or 5VU - Press CAPT or F/O GPWS/G/S indicator light, hold for more 7 s, and release.	The following test sequence runs: On panel 402VU - The FAULT legend of the GPWS annunciator comes on. The loudspeakers emit the following test sequence of aural warnings - GLIDESLOPE - WHOOP WHOOP PULL UP - SINK RATE - WHOOP WHOOP PULL UP - TERRAIN - WHOOP WHOOP PULL UP - DON'T SINK - TOO LOW TERRAIN - TOO LOW GEAR - TOO LOW FLAPS - TOO LOW TERRAIN - GLIDESLOPE - MINIMUMS On panel 402VU - The FAULT legend of the GPWS annunciator goes off.

**ON A/C 005-100,

(3)Cockpit Self Test

ACTION	RESULT
1. On panel 3VU or 5VU - Press CAPT or F/O GPWS/G/S	The following test sequence runs:

ACTION	RESULT
indicator light momentarily, and release.	On panel 402VU - The FAULT legend of the GPWS annunciator comes on. The internal BITE test runs for 1.5 s. On panels 3VU and 5VU - The G/S legend of the GPWS/G/S indicator lights comes on and the loudspeakers emit GLIDESLOPE. - The G/S legend of the GPWS/G/S indicator lights goes off. - The GPWS legend of the GPWS/G/S indicator lights comes on and the loudspeakers emit WHOOP-WHOOP PULL UP. - The GPWS legend of the GPWS/G/S indicator lights goes off. On panel 402VU - The FAULT legend of the GPWS annunciator goes off.
2. On panel 3VU or 5VU - Press CAPT or F/O GPWS/G/S indicator light, hold for more than 7 s, and release.	The following test sequence runs: On panel 402VU - The FAULT legend of the GPWS annunciator comes on. On panels 3VU ad 5VU - The G/S legend of the GPWS/G/S indicator lights comes on and the loudspeakers emit GLIDESLOPE. - The G/S legend of the GPWS/G/S indicator lights goes off. - The GPWS legend of the GPWS/G/S indicator lights comes on and the loudspeakers emit WHOOP-WHOOP PULL UP. - The GPWS legend of the GPWS/G/S indicator lights goes off. The loudspeakers continue with the aural warnings - SINK RATE - WHOOP WHOOP PULL UP - TERRAIN - WHOOP WHOOP PULL UP - DON'T SINK - TOO LOW TERRAIN - TOO LOW GEAR

ACTION	RESULT
	- TOO LOW FLAPS - TOO LOW TERRAIN - GLIDESLOPE - MINIMUMS, MINIMUMS On panel 402VU - The FAULT legend of the GPWS annunciator goes off.

R **ON A/C 001-004,

(4)Status/History Test

ACTION	RESULT
1. In the avionics compartment, in the electronics rack 86VU, on the GPWC front panel - Press the STATUS/HISTORY switch to the PRESENT STATUS position, hold for 1 s minimum, and release.	In the avionics compartment, on the GPWC front panel BITE display - An all segment test runs. - GPWS OK is indicated (or any other present status). - END TEST is indicated.
2. In the avionics compartment, in the electronics rack 86VU, on the GPWC front panel - Press the STATUS/HISTORY switch to the FLIGHT HISTORY position, hold for 1 s minimum, and release.	In the avionics compartment, on the GPWC front panel BITE display - An all segment test runs. - PREVIOUS TEN FLIGHTS OK or the failure history of the ten previous flights is indicated. NOTE : If the display sequence shows a system failure during the previous ten flights, note the exact message and continue test. - QNH SELECTED is indicated. - END TEST is indicated.

(5)Close-Up
(a)On panel 417VU close the safety cover of the WARNING SYS/EMER CANCEL switch and install the copper safety wire (dia. 0.5 mm).
(b)Set the LDG GEAR/POSITION DET/SYS1/SYS2 switch (10GA) to the SYS1 position.
(c)De-energize RA1 (Ref. 34-42-00, P. Block 501).
(d)De-energize ILS (Ref. 34-36-00, P. Block 501).
(e)De-engerize IRS (Ref. 34-25-00, P. Block 501).

(f)De-energize ADC (Ref. 34-10-00, P. Block 501).
(g)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(h)Make certain that the work area is clean and clear of tools and miscellaneous items of equipment.

**ON A/C 005-100,

(4)Status/History Test

ACTION	RESULT
1. In the avionics compartment, in the electronics rack 86VU, on the GPWC front panel - Press the STATUS/HISTORY switch to the PRESENT STATUS position, hold for 1 s minimum, and release.	In the avionics compartment, on the GPWC front panel BITE display the following indications scroll - All segments of all indicator digits come on - IN TEST - AIRCRAFT TYPE x, (x is a substitute for a number) - List of selected options (e.g., ALT MODE 4 SELECTED.) - SYSTEM OK - SOFTWARE VERSION IS yyyyyyy, (y's are substitutes for a version code) - DATA BASE VERSION IS zzz, date, (z's are substitutes for a version code) - END TEST
2. In the avionics compartment, in the electronics rack 86VU, on the GPWC front panel - Press the STATUS/HISTORY switch to the FLIGHT HISTORY position, hold for 1 s minimum, and release	In the avionics compartment, on the GPWC front panel BITE display the following indications scroll - FAULT HISTORY *** - GPWS OK or GPWS FAILED followed by the failure history of the previous ten flights. NOTE : If the display sequence shows a system failure during the previous ten flights, note the exact message and continue test. - END TEST

(5)Close-Up

(a) On panel 417VU close the safety cover of the WARNING SYS/EMER CANCEL switch and install the copper safety wire (dia. 0.5 mm).
(b) Set the LDG GEAR/POSITION DET/SYS1/SYS2 switch (10GA) to the SYS1 position.
(c) De-energize RA1 (Ref. 34-42-00, P. Block 501).
(d) De-energize ILS (Ref. 34-36-00, P. Block 501).
(e) De-engerize IRS (Ref. 34-25-00, P. Block 501).
(f) De-energize ADC (Ref. 34-10-00, P. Block 501).
(g) De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(h) Make certain that the work area is clean and clear of tools and miscellaneous items of equipment.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

ENHANCED GROUND PROXIMITY WARNING SYSTEM ADJUSTMENT/TEST

**ON A/C 101-200,

1. Operational Test

A. Reason for the Job

(1) This procedure has the subsequent tests to verify the correct operation through the BIT capabilities of the EGPWC. A high level of confidence in the EGPWS installation can be achieved by the initiation of the EGPWS self test. The EGPWS self test is divided into six levels. These are:

Level 1	Operations
Level 2	Current Faults.
Level 3	System Configuration.
Level 4	Fault History.
Level 5	Warning History.
Level 6	Discrete Input Test.

(2) Only the level 1 test is required for the operational test. If a failure occurs level 2 and subsequent can be utilised to locate the fault. See Description & Operation 34-48-00-1 for further details on the self test functions.

B. Referenced Procedures

- 24-41-00, P. Block 301	AC External Power Control
- 34-10-00, P. Block 501	Air Data Computer (ADC)
- 34-25-00, P. Block 501	Inertial Reference System (IRS)
- 34-36-00, P. Block 501	ILS Receiver
- 34-42-00, P. Block 501	Radio Altimeter (RA1)
- 34-60-00, P. Block 501	Flight Management System (FMS)

C. Procedure

**ON A/C 101-104,

(Ref. Fig. 501)

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

R Post SB 34-2206 For A/C 101-200,

(Ref. Fig. 502)

**ON A/C 101-200,

R

(1)Job Set-Up

NOTE : Hydraulic pressure will be required during the Level 6 test.

(a)Connect the electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make sure that the electronics racks ventilation is correct.
(c)Check that the ADC1 is energized (Ref. 34-10-00, P. Block 501).
(d)Energize the IRS1 and the IRS2 (Ref. 34-25-00, P. Block 501).
(e)Check that the ILS1 and the ILS2 are energized (Ref. 34-36-00, P. Block 501).
(f)Check that the RA1 is energized (Ref. 34-42-00, P. Block 501).
(g)Make sure that the LDG GEAR/POSITION DET/SYS1/SYS2 switch (10GA) is in the SYS2 position.
(h)Make sure that the NORM/FLAP OVRD/OFF switch (12WZ) is in the NORM position and guarded.
(j)Make sure that the FMC1 and the FMC2 are in operation (AMM 34-60-00, P. Block 501).
(k)Make sure that the EFIS NDs are in a mode which supports WXR such as ARC or MAP.
(l)Make sure that the FAULT legend on TERR MODE pushbutton switch (31WZ) is off.
(m)On the center pedestal, on the weather radar control box, set the mode selector switch to TEST and the SYS switch to 1.

CAUTION : BEFORE THE TEST OF THE EGPWS, MAKE SURE THAT THE BAROMETRIC CORRECTION ON THE ALTIMETER IS SET BETWEEN 22 AND 31 IN HG. IF NOT IN THIS RANGE, THE BAROMETRIC ALTITUDE IS NOT SEEN AS A VALID DATA AND THE TEST IS NOT POSSIBLE.

(n)Make sure that the following circuit breakers are closed:

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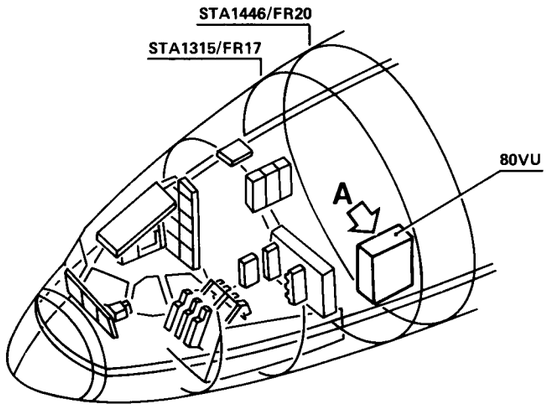

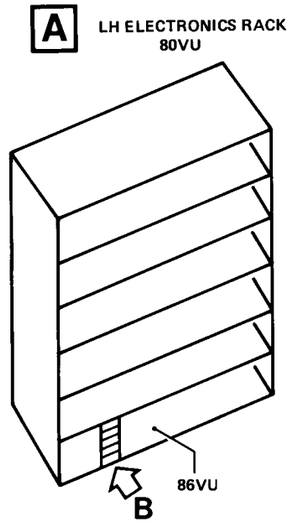

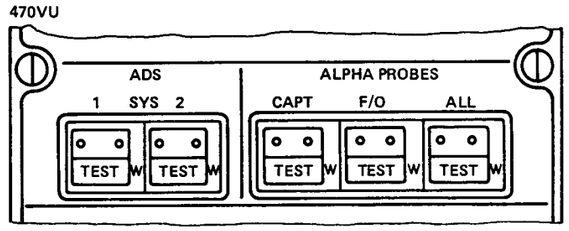

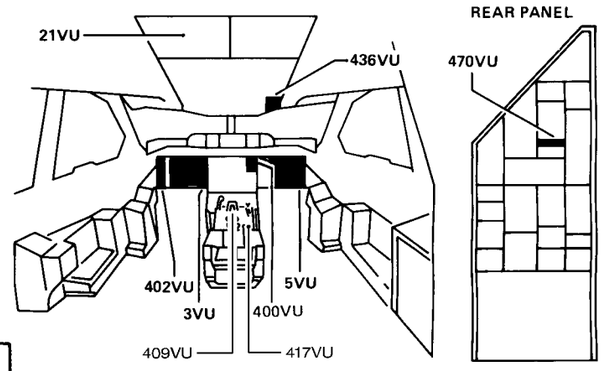

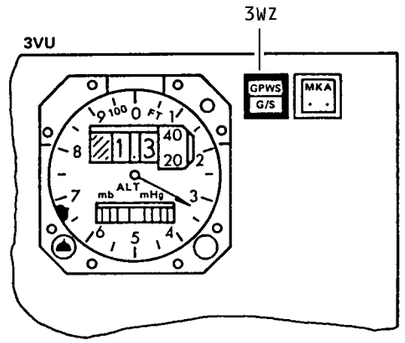

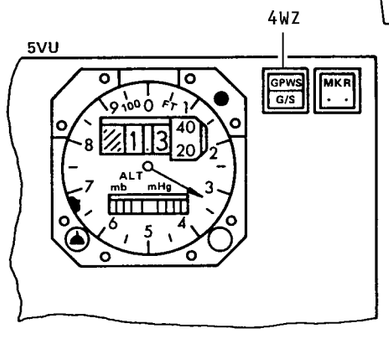

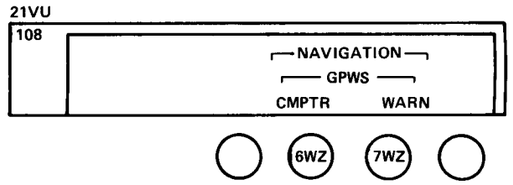

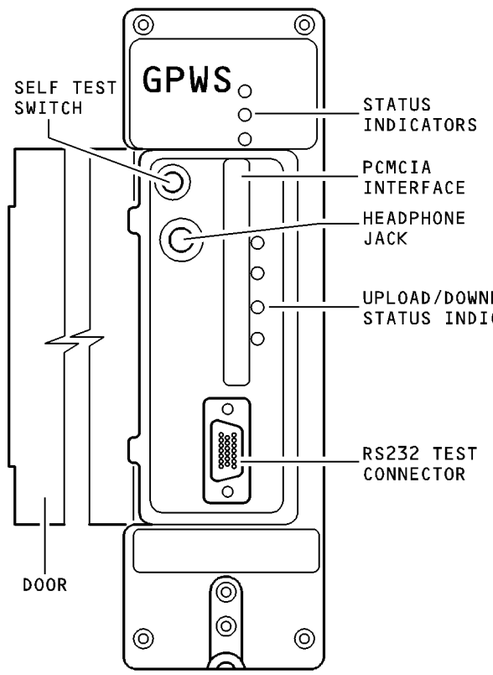

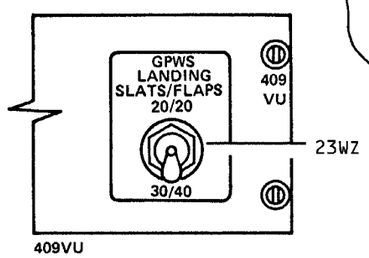

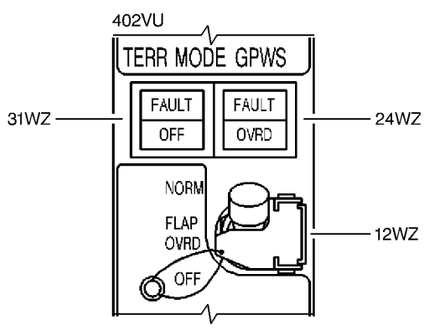

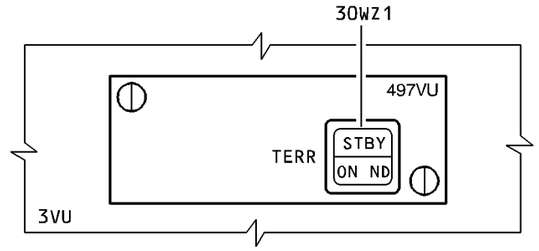

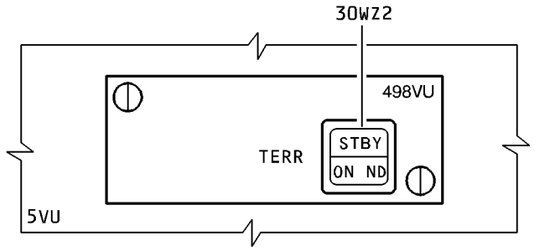

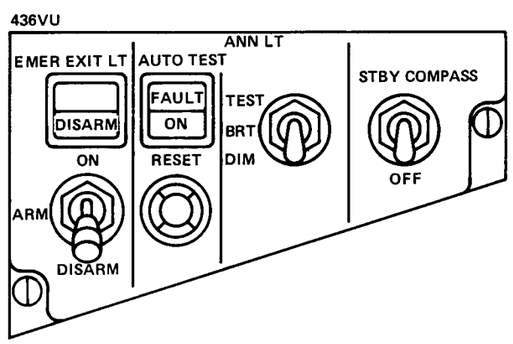

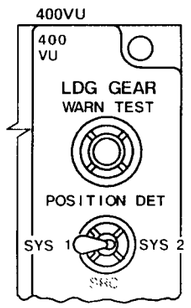

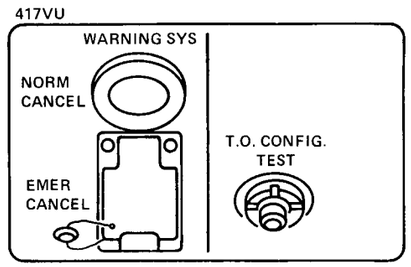

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EGPWS - Test Components
Figure 501

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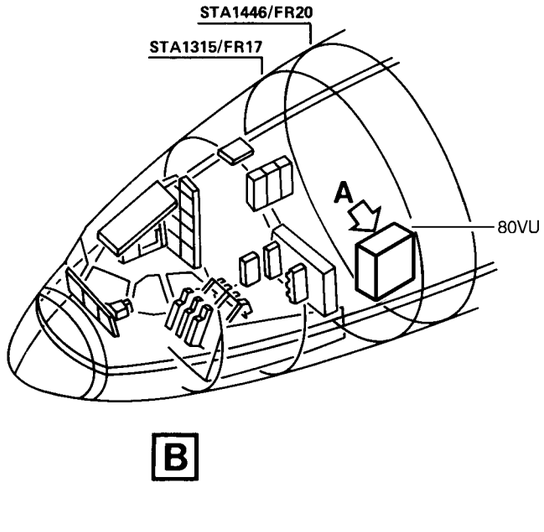

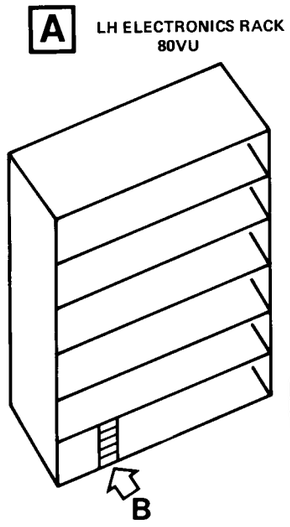

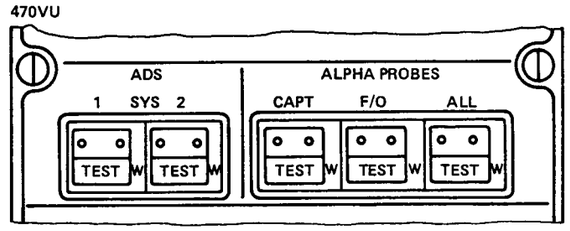

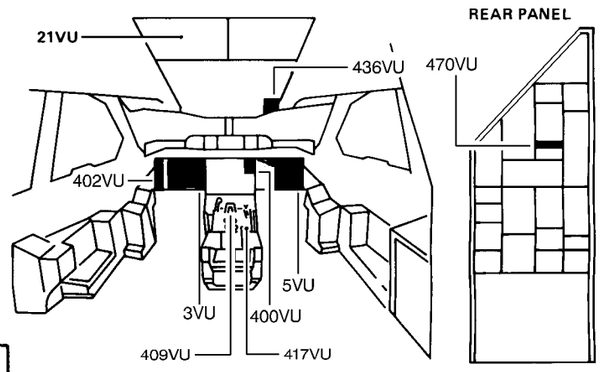

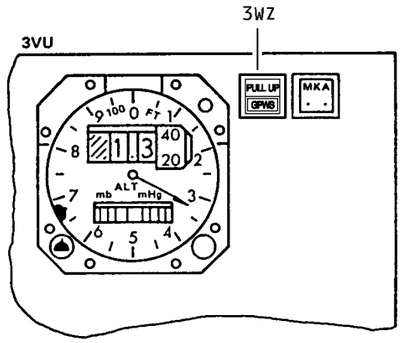

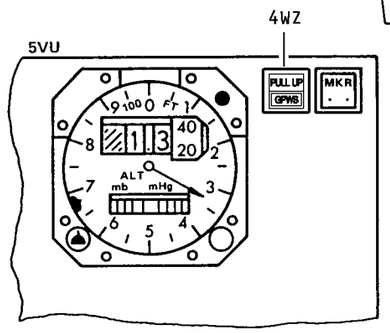

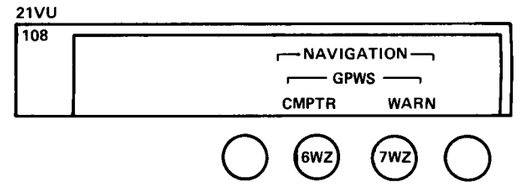

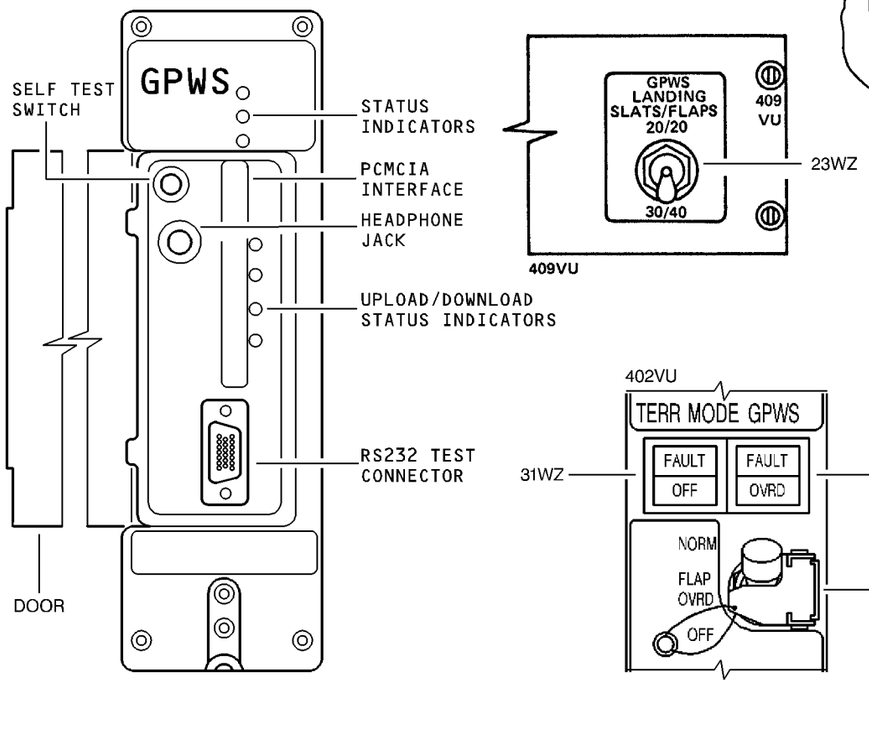

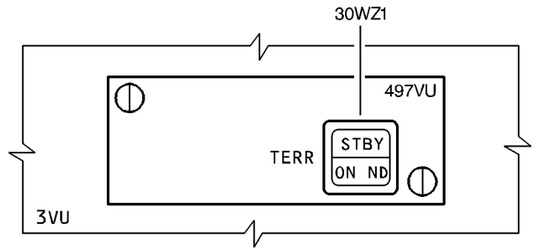

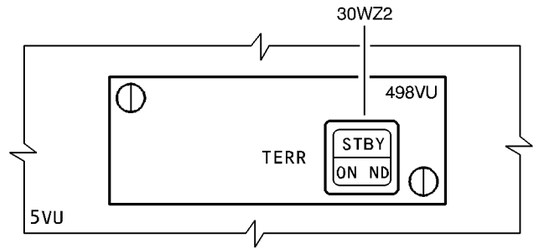

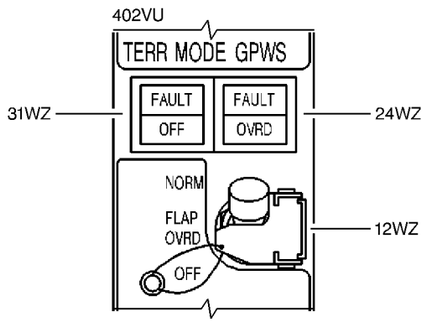

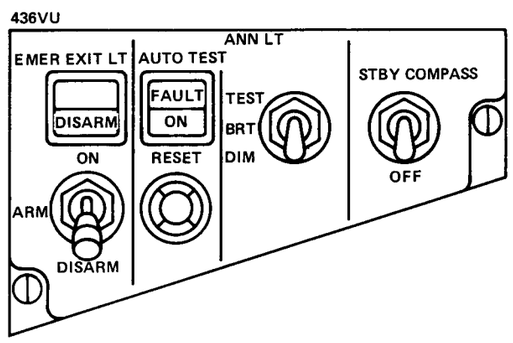

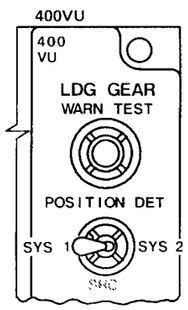

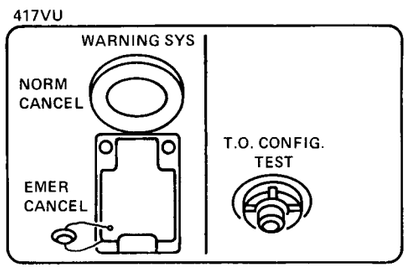

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EGPWS - Test Components
Figure 502

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION GPWS/CMPTR	6WZ	108/B11
21VU	NAVIGATION GPWS/WARN	7WZ	108/B12
133VU	HYDRAULIC/L/G PROX DET/RELAYS SYS 1 AND RETRACT CTL	2GB	332/U51
133VU	HYDRAULIC/L/G PROX DET AND RELAYS SYS 1 FLT/GND	119GB	332/U52
133VU	HYDRAULIC/L/G PROX DET/RELAYS SYS 1 GEAR DOWN/CTR PNL POS IND	3GB	333/U53
133VU	HYDRAULIC/L/G PROX DET/RELAYS SYS 2 GEAR DOWN/OVHD PNL POS IND	83GB	331/V51
133VU	HYDRAULIC/L/G PROX DET AND RELAYS SYS 2 FLT/GND	1GB	331/V52

**ON A/C 101-104,

(2)Tests
(a)Self Test Level 1 - Operations

NOTE : The Self Test Aural volume is 6 dB lower than the Warning Aural volume.

NOTE : During normal maintenance operation, the Self Test may be initiated via the SELF TEST switch on the face of the EGPWC.

ACTION	RESULT
1. In the flight compartment, on panel 3VU : - press and hold CAPT GPWS/G/S indicator light (3WZ) for less than 2 seconds.	In the flight compartment : - the FAULT legend of the GPWS annunciator (24WZ) comes on. - the FAULT legend of the TERR MODE pushbutton switch (31WZ) comes on. - the G/S legends of the GPWS/G/S indicator lights (3WZ and 4WZ) come on. the aural "GLIDE SLOPE" warning is enunciated. - the G/S legends of the GPWS/G/S indicator lights (3WZ and 4WZ) go off. - the GPWS legends of the GPWS/G/S indicator lights (3WZ and 4WZ)

ACTION	RESULT
	come on. - the aural "PULL UP" warning is enunciated. - the aural "TERRAIN AHEAD PULL UP" warning is enunciated. - the ON ND legends of the TERR pushbutton switches (30WZ1 and 30WZ2) come on. - on the NDs, the terrain display self test pattern is shown after several sweeps of the terrain display. - the GPWS legends of the GPWS/G/S indicator lights (3WZ and 4WZ) go off. - the ON ND legends of the TERR pushbutton switches (30WZ1 and 30WZ2) go off. - on the NDs, the terrain display self test pattern goes off. NOTE : The terrain display can remain on for approximately 10 seconds after the legends of the TERR pushbutton switches (30WZ1 and 30WZ2) go off. - the FAULT legend of the GPWS annunciator (24WZ) goes off. - the FAULT legend of the TERR MODE pushbutton switch (31WZ) goes off. - the aural "GLIDE SLOPE" warning stops. - the aural "PULL UP" warning stops.
2. On panel 5VU: - press F/O GPWS/G/S indicator light (4WZ) for more than 5 seconds.	The following warnings are enunciated: - GLIDE SLOPE - PULL UP - TERRAIN AHEAD PULL UP - SINK RATE - PULL UP - TERRAIN - PULL UP - DON'T SINK DON'T SINK - TOO LOW TERRAIN

ACTION	RESULT
	- TOO LOW GEAR - TOO LOW FLAPS - TOO LOW TERRAIN - GLIDE SLOPE - BANK ANGLE (if pin prog activated) - BANK ANGLE (if pin prog activated) - TOO LOW TERRAIN - TERRAIN AHEAD - TERRAIN AHEAD - TERRAIN AHEAD PULL UP

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

(2)Tests
(a)Self Test Level 1 - Operations

NOTE : The Self Test Aural volume is 6 dB lower than the Warning Aural volume.

NOTE : During normal maintenance operation, the Self Test may be initiated via the SELF TEST switch on the face of the EGPWC.

ACTION	RESULT
1. In the flight compartment, on panel 3VU : - press and hold CAPT PULL UP/GPWS indicator light (3WZ) for less than 2 seconds.	In the flight compartment : - the FAULT legend of the GPWS annunciator (24WZ) comes on. - the FAULT legend of the TERR MODE pushbutton switch (31WZ) comes on. - the GPWS legends of the PULL UP/ GPWS indicator lights (3WZ and 4WZ) come on. the aural "GLIDE SLOPE" warning is enunciated. - the aural "GLIDE SLOPE" warning stops - the GPWS legends of the PULL UP/ GPWS indicator lights (3WZ and 4WZ) go off. - the PULL UP legends of the PULL UP/

ACTION	RESULT
	GPWS indicator lights (3WZ and 4WZ) come on. - the aural "PULL UP" warning is enunciated. - the aural "PULL UP" warning stops. - the aural "TERRAIN AHEAD PULL UP" warning is enunciated. - the ON ND legends of the TERR pushbutton switches (30WZ1 and 30WZ2) come on. - on the NDs, the terrain display self test pattern is shown after several sweeps of the terrain display. - the PULL UP legends of the PULL UP/ GPWS indicator lights (3WZ and 4WZ) go off. - the ON ND legends of the TERR pushbutton switches (30WZ1 and 30WZ2) go off. - on the NDs, the terrain display self test pattern goes off. NOTE : The terrain display can remain on for approximately 10 seconds after the legends of the TERR pusbutton switches (30WZ1 and 30WZ2) go off. - the FAULT legend of the GPWS annunciator (24WZ) goes off. - the FAULT legend of the TERR MODE pushbutton switch (31WZ) goes off.
2. On panel 5VU, press F/O PULL UP/GPWS indicator light (4WZ) for more than 5 seconds	The following warnings are enunciated: - GLIDE SLOPE - PULL UP - TERRAIN AHEAD PULL UP - SINK RATE - PULL UP - TERRAIN - PULL UP - DON'T SINK DON'T SINK - TOO LOW TERRAIN - TOO LOW GEAR - TOO LOW FLAPS

ACTION	RESULT
	- TOO LOW TERRAIN - GLIDE SLOPE - BANK ANGLE (if pin prog activated) - BANK ANGLE (if pin prog activated) - TOO LOW TERRAIN - TERRAIN AHEAD - TERRAIN AHEAD - TERRAIN AHEAD PULL UP

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

Post SB 34-2207 For A/C 101-200,

(2)Tests
(a)Self Test Level 1 - Operations

NOTE : The Self Test Aural volume is 6 dB lower than the Warning Aural volume.

NOTE : During normal maintenance operation, the Self Test may be initiated via the SELF TEST switch on the face of the EGPWC.

ACTION	RESULT
R 1. In flight compartment, on panel 3VU: R - press and hold CAPT PULL UP/GPWS pushbutton switch (3WZ) for less than 2 seconds.	In flight compartment, on panel 2VU or 402VU: - FAULT legend of GPWS annunciator (24WZ) comes on. - FAULT legend of TERR MODE pushbutton switch (31WZ) comes on. On panels 3VU and 5VU: - GPWS legends of PULL UP/GPWS pushbutton switches (3WZ and 4WZ) come on. In loudspeakers: - aural "GLIDE SLOPE" warning is enunciated. - aural "GLIDE SLOPE" warning stops. On panels 3VU and 5VU:

ACTION	RESULT
	- GPWS legends of PULL UP/GPWS pushbutton switches (3WZ and 4WZ) go off. - PULL UP legends of PULL UP/GPWS pushbutton switches (3WZ and 4WZ) come on. In loudspeakers: - aural "PULL UP" warning is enunciated. - aural "PULL UP" warning stops. - aural "TERRAIN AHEAD PULL UP" warning is enunciated. - aural "TERRAIN AHEAD PULL UP" warning stops. On panels 497VU and 498VU: - ON ND legends of TERR pushbutton switches (30WZ1 and 30WZ2) come on. On panels 3VU and 5VU: - on NDs (36FN1 and 36FN2), terrain display self test pattern is shown after several sweeps of terrain display. - PULL UP legends of PULL UP/GPWS pushbutton switches (3WZ and 4WZ) go off. On panels 497VU and 498VU: - ON ND legends of TERR pushbutton switches (30WZ1 and 30WZ2) go off. On panels 3VU and 5VU: - on NDs (36FN1 and 36FN2), terrain display self test pattern goes out of view. NOTE : The terrain display can remain on for approximately 10 seconds after the legends of the TERR pusbutton switches (30WZ1 and 30WZ2) go off. On panel 2VU or 402VU: - FAULT legend of GPWS annunciator (24WZ) goes off. - FAULT legend of TERR MODE pushbutton switch (31WZ) goes off.
2. On center pedestal, on weather radar control box (3SQ): - set SYS switch to OFF.	

ACTION	RESULT
3. On panel 5VU: - press and hold F/O PULL UP/GPWS pushbutton switch (4WZ) for more than 5 seconds.	In loudspeakers, the following warnings are enunciated: - GLIDE SLOPE - PULL UP - TERRAIN AHEAD PULL UP - SINK RATE - PULL UP - TERRAIN - PULL UP - DON'T SINK DON'T SINK - TOO LOW TERRAIN - TOO LOW GEAR - TOO LOW FLAPS - TOO LOW TERRAIN - GLIDE SLOPE - BANK ANGLE (if pin prog activated) - BANK ANGLE (if pin prog activated) - TOO LOW TERRAIN - TERRAIN AHEAD - TERRAIN AHEAD - TERRAIN AHEAD PULL UP - OBSTACLE AHEAD - OBSTACLE AHEAD - OBSTACLE AHEAD PULL UP

**ON A/C 101-104,

(b)Self Test Level 2 - Current Faults

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 1 must be performed before the Self Test Level 2 can be initiated.

ACTION	RESULT
1. In the flight compartment, on panel 3VU or 5VU: - press and hold the GPWS/G/S indicator light (3WZ or 4WZ) for less than 2 seconds.	In the flight compartment: - the Self Test Level 1 indication and message sequence begins.

ACTION	RESULT
2. When during the Self Test Level 1 the aural messages start, on panel 3VU or 5VU: - press and hold the GPWS/G/S indicator light (3WZ or 4WZ) for less than 2 seconds to start Self Test Level 2.	- the subsequent aural messages are enunciated: *"CURRENT FAULTS" *"NO FAULTS" *"PRESS TO CONTINUE". NOTE : If an EGPWS computer or system fault exists, the fault(s) will be enunciated as EGPWS internal faults and/or EGPWS external faults. The aural messages will provide a description of the fault(s).

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

(b)Self Test Level 2 - Current Faults

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 1 must be performed before the Self Test Level 2 can be initiated.

ACTION	RESULT
R 1. In flight compartment, on panel 3VU or 5VU: R - press and hold PULL UP/GPWS R pushbutton switch (3WZ or 4WZ) for less than 2 seconds.	In flight compartment: - Self Test Level 1 indication and message sequence start.
R 2. When during Self Test Level 1 R aural messages start, on panel 3VU or 5VU: R - press and hold PULL UP/GPWS R pushbutton switch (3WZ or 4WZ) for less than 2 seconds to start Self Test Level 2.	- In loudspeakers, these aural messages are enunciated: *"CURRENT FAULTS" *"NO FAULTS" *"PRESS TO CONTINUE".

ACTION	RESULT
	NOTE : If an Enhanced GPWC or system fault exists, the fault(s) will be enunciated as EGPWS internal faults and/or EGPWS external faults. The aural messages will provide a description of the fault(s).

**ON A/C 101-104,

(c)Self Test Level 3 - System Configuration

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE Pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 3 must be performed before the Self Test Level 2 has been completed.

ACTION	RESULT
1. In the flight compartment: - do the Self Test Level 2, if it has not been performed immediately before this step.	
2. Within 3 seconds after the aural message "PRESS TO CONTINUE" has been enunciated: - press and hold the GPWS/G/S indicator light (3WZ or 4WZ) for less than 2 seconds to start the Self Test Level 3.	In the flight compartment: - the subsequent aural messages are enunciated: NOTE : In the subsequent messages listed, X's represent either numbers, letters, the word "POINT" or no annunciation (e.g. the serial number can be enunciated as "SERIAL" NUMBER 316"). *"SYSTEM CONFIGURATION" *"PART NUMBER 965-0976-0XX-XXX-XXX" *"MOD STATUS X"

ACTION	RESULT
	*"SERIAL NUMBER X" *"APPLICATION SOFTWARE VERSION X" *"CONFIGURATION SOFTWARE VERSION X" *"TERRAIN DATABASE VERSION X" *"ENVELOPE MOD DATABASE VERSION X" *"BOOT CODE VERSION X" *"AIRCRAFT TYPE X" *"AUDIO MENU X" *"ALTITUDE CALLOUT MENU X" *"DUAL ILS SELECTED (if pin program wired) *"BANK ANGLE SELECTED (if pin program wired) *"PRESS TO CONTINUE" NOTE : See ASM 34-48-00, SCHEM 02 for the pin program wiring.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

Post SB 34-2207 For A/C 101-200,

(c)Self Test Level 3 - System Configuration

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 3 must be initialized before the Self Test Level 2 has been completed.

ACTION	RESULT
R 1. In flight compartment: R - do Self Test Level 2, if it	

ACTION	RESULT
R has not been performed R immediately before this step.	
R 2. Within 3 seconds after aural R message "PRESS TO CONTINUE" R has been enunciated, on panel 3VU R or 5VU: R - press and hold PULL UP/GPWS R pushbutton switch (3WZ or 4WZ) R for less than 2 seconds to R start Self Test Level 3.	In flight compartment, in loudspeakers: - the subsequent aural messages are enunciated: NOTE : In the subsequent messages listed, X's represent either numbers, letters, the word "POINT" or no annunciation (e.g. the serial number can be enunciated as "SERIAL" NUMBER 316"). *"SYSTEM CONFIGURATION" *"PART NUMBER 965-1676-002" *"MOD STATUS X" *"SERIAL NUMBER X" *"SOFTWARE VERSION X" *"TERRAIN DATABASE VERSION X" *"ENVELOPE MOD DATABASE VERSION X" *"BOOT CODE VERSION X" *"AIRCRAFT TYPE X" *"AUDIO MENU X" *"ALTITUDE CALLOUT MENU X" *"CONFIGURATION OPTION 1 SELECTED" *"LAND FORMAT 2 SELECTED" *"OPTIONAL INPUTS SELECTED" *"SINGLE GPS SELECTED" *"PEAK ENABLE" R *"OBSTACLE AWARENESS ENABLED" *"PRESS TO CONTINUE" NOTE : See ASM 34-48-00, SCHEM 02 for the pin program wiring.

**ON A/C 101-104,

(d)Self Test Level 4 - Fault History

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 4 must be performed immediately after the Self Test Level 3 has started. Be aware that Level 3 required the completion of Levels 1 through 2.

	ACTION	RESULT
R	1. In flight compartment: - start Self Test Level 3, if it has not been performed immediately before this step.	
R	2. When during Self Test Level 3 message "SYSTEM CONFIGURATION" has been enunciated, on panel 3VU or 5VU: - press and hold GPWS/G/S indicator light (3WZ or 4WZ) for a time between 2 and 8 seconds to cut short Self Test Level 3.	In flight compartment, in loudspeakers: - the aural message is enunciated: "PRESS TO CONTINUE". NOTE : The operator can skip step 2 and start the subsequent test steps immediately following the last annunciation of Self Test Level 3.
R	3. Within 3 seconds after aural message "PRESS TO CONTINUE" has been enunciated, on panel 3VU or 5VU: - press and hold GPWS/G/S indicator light (3WZ or 4WZ) for less than 2 seconds to start Self Test Level 4.	In flight compartment, in loudspeakers: - the aural message "NO FAULTS" is enunciated, if no faults occurred during the previous 10 flight legs. - if otherwise, Self Test Level 2 messages are enunciated followed by flight leg and fault information, e.g.: *"FLIGHT 4" *"EGPWC OK" *"EXTERNAL FAULTS" *"RADIO ALTIMETER BUS 1 INACTIVE" *"PRESS TO CONTINUE"

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

(d)Self Test Level 4 - Fault History

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 4 must be initialized immediately after the Self Test Level 3 has started. Be aware that Level 3 required the completion of Levels 1 through 2.

	ACTION	RESULT
R	1. In flight compartment: R - start Self Test Level 3, if it has not been performed immediately before this step.	
R	2. When during Self Test Level 3 message "SYSTEM CONFIGURATION" has been enunciated, on panel 3VU or 5VU: R - press and hold PULL UP/GPWS pushbutton switch (3WZ or 4WZ) for a time between 2 and 8 seconds to cut short Self Test Level 3.	In flight compartment, in loudspeakers: - the aural message is enunciated: "PRESS TO CONTINUE." NOTE : The operator can skip step 2 and start the subsequent test steps immediately following the last annunciation of Self Test Level 3.
R	3. Within 3 seconds after aural message "PRESS TO CONTINUE" has been enunciated, on panel 3VU or 5VU: R - press and hold PULL UP/GPWS pushbutton switch (3WZ or 4WZ) for less than 2 seconds to start Self Test Level 4.	In flight compartment, in loudspeakers: - the aural message "NO FAULTS" is enunciated, if no faults occurred during the previous 10 flight legs. - otherwise, Self Test Level 2 messages are enunciated followed by flight leg and fault informa-

ACTION	RESULT
	tion, e.g.: *"FLIGHT 4" *"EGPWC OK" *"EXTERNAL FAULTS" *"RADIO ALTIMETER BUS 1 INACTIVE" *"PRESS TO CONTINUE"

**ON A/C 101-104,

(e)Self Test Level 5 - Warning History

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 5 must be performed immediately after the Self Test Level 4 has ended. Be aware that Level 4 required the completion of Levels 1 through 3.

ACTION	RESULT
R 1. In flight compartment: R - start Self Test Level 4, if it has not been performed immediately before this step.	
R 2. Within 3 seconds after aural message "PRESS TO CONTINUE" has been enunciated, on panel 3VU or 5VU: R - press and hold GPWS/G/S indicator light (3WZ or 4WZ) for less than 2 seconds to start Self Test Level 5.	In flight compartment, in loudspeakers: - the aural message "NO WARNINGS" is enunciated, if no alerts occurred during the previous 10 flight legs. - if otherwise, alert messages are enunciated, e.g.: *"WARNING HISTORY" *"FLIGHT 7" *"GLIDE SLOPE" *"PRESS TO CONTINUE"

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

(e)Self Test Level 5 - Warning History

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 5 must be performed immediately after the Self Test Level 4 has ended. Be aware that Level 4 required the completion of Levels 1 through 3.

	ACTION	RESULT
R	1. In flight compartment: - start Self Test Level 4, if it has not been performed immediately before this step.	
R	2. Within 3 seconds after aural message "PRESS TO CONTINUE" has been enunciated, on panel 3VU or 5VU: - press and hold PULL UP/GPWS pushbutton switch (3WZ or 4WZ) for less than 2 seconds to start Self Test Level 5.	In flight compartment, in loudspeakers: - the aural message "NO WARNINGS" is enunciated, if no alerts occurred during previous 10 flight legs. - otherwise, alert messages are enunciated, e.g.: *"WARNING HISTORY" *"FLIGHT 7" *"GLIDE SLOPE" *"PRESS TO CONTINUE"

**ON A/C 101-104,

(f)Self Test Level 6 - Discrete Input Test

NOTE : Hydraulic power is required for the subsequent test.

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch
R (31WZ) will be on throughout this test.

NOTE : The Self Test Level 6 must be performed immediately after the Self Test Level 5 has ended. Be aware that Level 5 required the completion of Levels 1 through 4.

ACTION	RESULT
1. In the flight compartment: - start the Self Test Level 5, if it has not been performed immediately before this step.	
2. Within 3 seconds after the aural message "PRESS TO CONTINUE" has been heard: - press and hold the GPWS/G/S indicator light (3WZ or 4WZ) for less than 2 seconds to start the Self Test Level 6.	In the flight compartment: - the aural message "DISCRETE INPUT TEST - PRESS TO CANCEL" is heard. NOTE : The words "DISCRETE" INPUT TEST - PRESS TO CANCEL" are heard and repeated approximately every 60 seconds throughout this test.
3. On panel 133VU: - open the circuit breaker HYDRAULIC /L/G PROX DET AND RELAYS SYS2 /GEAR DOWN AND OVHD PNL POS IND (83GB), location V51.	In the flight compartment: - the aural message "LANDING GEAR UP" is heard.
4. On panel 133VU: - close the circuit breaker HYDRAULIC /L/G PROX DET AND RELAYS SYS2 /GEAR DOWN AND OVHD PNL POS IND (83GB), location V51.	In the flight compartment: - the aural message "LANDING GEAR DOWN" is heard.
5. On panel 402VU: - make sure that the NORM/FLAP OVRD/OFF switch (12WZ) is in the NORM position.	
6. On panel 409VU: - place the GPWS/LANDING/SLATS /FLAPS switch (23WZ) in the 20/20 position.	
7. Connect hydraulic power.	

ACTION	RESULT
8. On the center pedestal: - extend flaps from 0 deg. to the 20 deg. position (Ref.AMM 27-50-00, P. Block 301).	In the flight compartment: - the aural message "LANDING FLAPS" is heard.
9. On panel 409VU: - place the GPWS/LANDING/SLATS /FLAPS switch (23WZ) in the 30/40 position.	In the flight compartment: - the aural message "NOT LANDING FLAPS" is heard.
10. On the center pedestal: - extend flaps from 20 deg. to the 40 deg. position (Ref. AMM 27-50-00, P. Block 301). - retract flaps from 40 deg. to the 0 deg. position (Ref. AMM 27-50-00, P. Block 301).	In the flight compartment: - the aural message "LANDING FLAPS" is heard. - the aural message "NOT LANDING FLAPS" is heard.
11. Disconnect hydraulic power.	
12. On panel 402VU: - place the NORM/FLAP OVRD/OFF switch (12WZ) in the OVRD position.	In the flight compartment: - the aural message "LANDING FLAPS" is heard. - the OVRD legend of the GPWS annunciator (24WZ) comes on.
13. On panel 402VU: - place the NORM/FLAP OVRD/OFF switch (12WZ) in the OFF position.	In the flight compartment: - the aural messages "NOT LANDING FLAPS" and "GPWS INHIBIT" are heard.
14. On panel 402VU: - place the NORM/FLAP OVRD/OFF switch (12WZ) in the NORM position.	In the flight compartment: - the aural message "GPWS NOT INHIBIT" is heard.
15. On panel 417VU: - press and hold the EMER CANCEL switch between 5 and 20 seconds, - release the EMER CANCEL switch.	In the flight compartment: - the aural message "MOMENTARY AUDIO INHIBIT" is heard. - the aural message "MOMENTARY AUDIO NOT INHIBIT" is heard.
16. On panel 470VU: - press the ALPHA PROBES/ CAP/TEST switch for more than 60 seconds.	In the flight compartment: - the aural message "AUDIO INHIBIT" is enunciated.

ACTION	RESULT
- release the ALPHA PROBES/ CAPT/TEST switch.	- the aural message "AUDIO NOT INHIBIT" is heard.
17. On panel 47OVU: - press the ALPHA PROBES/ F/O/TEST switch.	In the flight compartment: - the aural message "AUDIO INHIBIT" is heard.
- release the ALPHA PROBES/ F/O/TEST switch.	- the aural message "AUDIO NOT INHIBIT" is heard.
18. On panel 402VU: - press the TERR MODE pushbutton switch (31WZ).	In the flight compartment: - the aural message "TERRAIN OFF" is heard. - the OFF legend of the TERR MODE pushbutton switch comes on.
- press again the TERR MODE pushbutton switch (31WZ).	- the aural message "TERRAIN ON" is heard.
19. On panel 3VU or 5 VU: - press and hold the GPWS/G/S indicator light (3WZ or 4WZ) for less than 2 seconds to exit the Self Test Level 6.	In the flight compartment: - the aural message "GLIDE SLOPE CANCELLED" is enunciated. - the OVRD legend of the GPWS annunciator (24WZ) goes off. - the OFF legend of the TERR MODE pushbutton switch (31WZ) goes off.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

Post SB 34-2206 For A/C 101-200,

(f)Self Test Level 6 - Discrete Input Test

NOTE : Hydraulic power is required for the subsequent test.

NOTE : The FAULT legend of the GPWS annunciator (24WZ) and the FAULT legend of the TERR MODE pushbutton switch (31WZ) will be on throughout this test.

NOTE : The Self Test Level 6 must be performed immediately after the Self Test Level 5 has ended. Be aware that Level 5 required the completion of Levels 1 through 4.

ACTION	RESULT
1. In flight compartment: - start Self Test Level 5, if it has not been performed immediately before this step.	
2. Within 3 seconds after aural message "PRESS TO CONTINUE" has been heard, on panel 3VU or 5VU: - press and hold PULL UP/GPWS pushbutton switch (3WZ or 4WZ) for less than 2 seconds to start Self Test Level 6.	In flight compartment, in loudspeakers: - aural message "DISCRETE INPUT TEST - PRESS TO CANCEL" is heard. NOTE : The words "DISCRETE" INPUT TEST - PRESS TO CANCEL" are heard and repeated approximately every 60 seconds throughout this test.
3. On panel 133VU: - open circuit breaker HYDRAULIC /L/G PROX DET AND RELAYS SYS2 /GEAR DOWN AND OVHD PNL POS IND (83GB), location V51.	In loudspeakers: - aural message "LANDING GEAR UP" is heard.
4. On panel 133VU: - close circuit breaker HYDRAULIC /L/G PROX DET AND RELAYS SYS2 /GEAR DOWN AND OVHD PNL POS IND (83GB), location V51.	In loudspeakers: - aural message "LANDING GEAR DOWN" is heard.
5. On panel 402VU: - make certain that NORM/FLAP OVRD/OFF switch (12WZ) is in NORM position.	In loudspeakers: - aural message "NOT LANDING FLAPS" is heard.
6. On panel 409VU: - press GPWS/LANDING SLATS/FLAPS pushbutton switch (23WZ) in 20/20 position (magnetically held).	In loudspeakers: - aural message "NOT LANDING FLAPS" is heard.
7. Connect hydraulic power.	
8. On center pedestal, on panel 9VU:	In loudspeakers:

ACTION	RESULT
- extend flaps from 0 deg. to 20 deg. position (Ref.AMM 27-50-00, P. Block 301).	- aural message "LANDING FLAPS" is heard.
9. On panel 409VU: - press GPWS/LANDING SLATS/FLAPS pushbutton switch (23WZ) in 30/40 position.	In loudspeakers: - aural message "NOT LANDING FLAPS" is heard.
10. On center pedestal, on panel 9VU: - extend flaps from 20 deg. to 40 deg. position (Ref. AMM 27-50-00, P. Block 301). - retract flaps from 40 deg. to 0 deg. position (Ref. AMM 27-50-00, P. Block 301).	In loudspeakers: - aural message "LANDING FLAPS" is heard. - aural message "NOT LANDING FLAPS" is heard.
11. Disconnect hydraulic power.	
12. On panel 402VU: - place NORM/FLAP OVRD/OFF switch (12WZ) in OVRD position.	In loudspeakers: - aural message "LANDING FLAPS" is heard. On panel 402VU: - OVRD legend of GPWS annunciator (24WZ) comes on.
13. On panel 402VU: - place NORM/FLAP OVRD/OFF switch (12WZ) in OFF position.	In loudspeakers: - aural messages "NOT LANDING FLAPS" and "GPWS INHIBIT" are heard.
14. On panel 402VU: - place NORM/FLAP OVRD/OFF switch (12WZ) in NORM position.	In loudspeakers: - aural message "GPWS NOT INHIBIT" is heard.
15. On panel 417VU: - press and hold EMER CANCEL switch (16WW) between 5 and 20 seconds, - release EMER CANCEL switch (16WW).	In loudspeakers: - aural message "MOMENTARY AUDIO INHIBIT" is heard. - aural message "MOMENTARY AUDIO NOT INHIBIT" is heard.
16. On maintenance panel 470VU: - press ALPHA PROBES/CAPT/TEST pushbutton switch (49FL1) for more than 60 seconds. - release ALPHA PROBES/CAPT/TEST pushbutton switch (49FL1).	In loudspeakers: - aural message "AUDIO INHIBIT" is heard. - aural message "AUDIO NOT INHIBIT" is heard.

ACTION	RESULT
17. On maintenance panel 470VU: - press ALPHA PROBES/F/O/TEST pushbutton switch (49FL2) for more than 60 seconds. - release ALPHA PROBES/F/O/TEST pushbutton switch (49FL2).	In loudspeakers: - aural message "AUDIO INHIBIT" is heard. - aural message "AUDIO NOT INHIBIT" is heard.
18. On panel 402VU: - press TERR MODE pushbutton switch (31WZ). - press again TERR MODE pushbutton switch (31WZ).	In loudspeakers: - aural message "TERRAIN OFF" is heard. On panel 402VU: - OFF legend of TERR MODE pushbutton switch (31WZ) comes on. In loudspeakers: - aural message "TERRAIN ON" is heard.
19. On panel 3VU or 5VU: - press and hold PULL UP/GPWS pushbutton switch (3WZ or 4WZ) for less than 2 seconds to exit Self Test Level 6.	In loudspeakers: - aural message "GLIDE SLOPE CANCELLED" is heard. On panel 402VU: - OVRD legend of GPWS annunciator (24WZ) goes off. - OFF legend of TERR MODE pushbutton switch (31WZ) goes off.

**ON A/C 101-200,

(3)Close-Up
(a)On panel 417VU, close the safety cover of WARNING SYS/EMER CANCEL switch and install the copper safety wire (Dia. 0.5 mm).
R (b)On panel 4VU, make certain that LDG GEAR/POSITION DET/SYS1/SYS2
R switch (10GA) is in SYS1 position.
(c)De-energize RA1 (Ref. 34-42-00, P. Block 501).
(d)De-energize ILS (Ref. 34-36-00, P. Block 501).
(e)De-energize ADC (Ref. 34-10-00, P. Block 501).
R (f)On panel 402VU, make certain that NORM/FLAP OVRD/OFF switch (12WZ)
R is in NORM position and guarded.
(g)De-energize FMS (Ref. 34-60-00, P. Block 501).
(h)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(i)Make certain that work area is clean and clear of tools and miscellaneous items of equipment.

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-48-00, P. Block 501	Ground Proximity Warning System

(Ref. Fig. 401)

R

2. Procedure

A. Job Set-Up
(1)Open access door 121BL.
(2)Open, safety and tag the following circuit breakers:

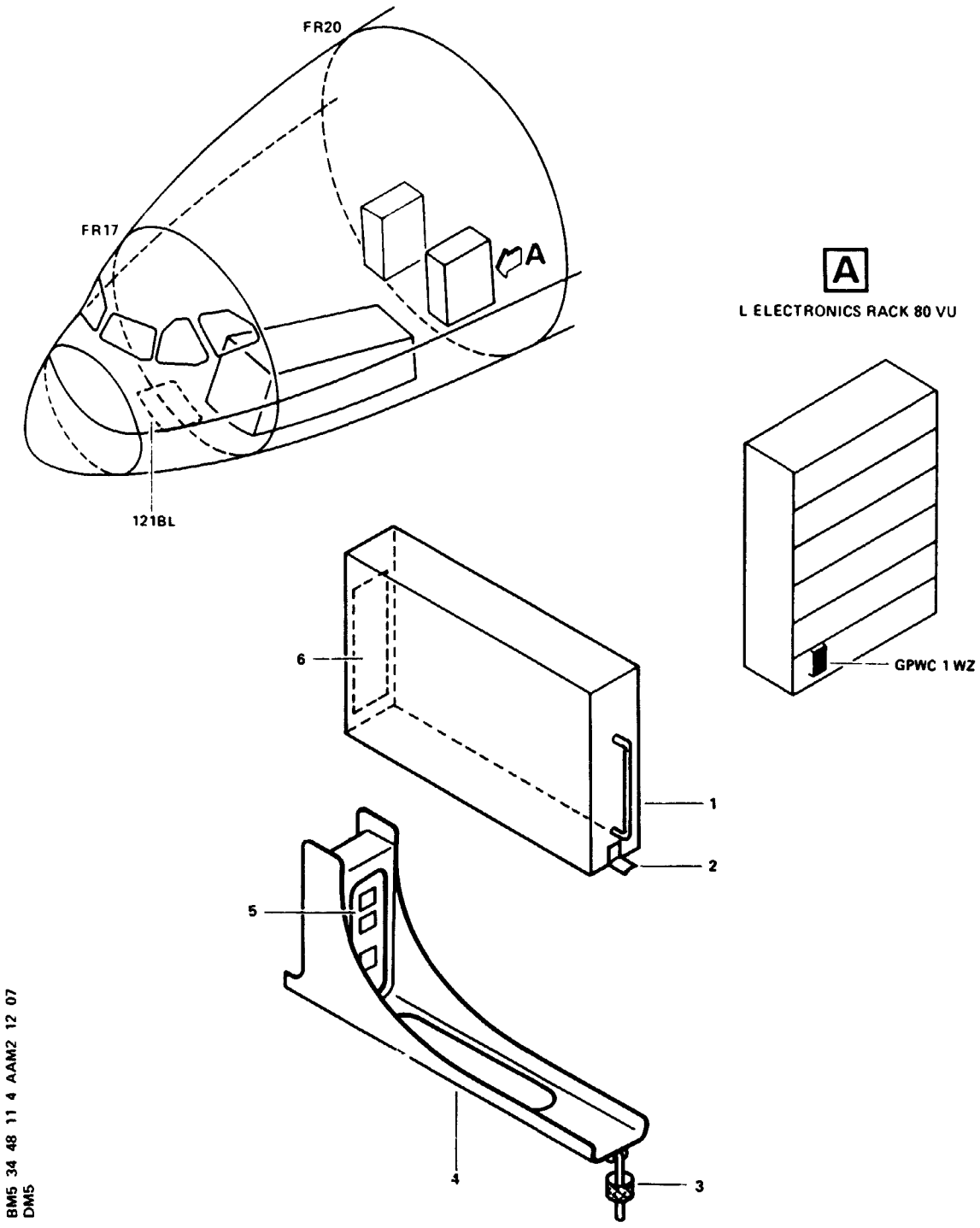
PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/GPWS - CMPTR	6WZ	108/B11
21VU	NAVIGATION/GPWS - WARN	7WZ	108/B12

B. Removal
(1)Unscrew retaining nut (3) until stud (2) is released.
(2)Withdraw computer (1) from rack (4) thus disconnecting electrical connectors (5) and (6).
(3)Blank electrical connectors (5) and (6).
(4)Remove computer.

C. Installation
(1)Clean and inspect computer interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (5) and (6). Visually check condition of pins.
(3)Position computer in rack (4) and push slowly on guide rails until resistance is felt.
(4)Lift retaining nut (3) into position on stud (2) and tighten.

D. Test
Carry out operational test of ground proximity warning computer (Ref. 34-48-00, P. Block 501).

**ON A/C 101-200,



Ground Proximity Warning Computer
Figure 401

R Post SB 34-2206 For A/C 101-200,

2. Procedure

A. Job Set-Up
(1)Open access door 121BL.
(2)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/GPWS - CMPTR	6WZ	108/B11
21VU	NAVIGATION/GPWS - WARN	7WZ	108/B12

B. Removal
(1)Unscrew retaining nut (3) until stud (2) is released.
(2)Withdraw computer (1) from rack (4) thus disconnecting electrical connectors (5) and (6).
(3)Blank electrical connectors (5) and (6).
(4)Remove computer.

C. Installation
(1)Clean and inspect computer interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (5) and (6). Visually check condition of pins.
(3)Position computer in rack (4) and push slowly on guide rails until resistance is felt.
(4)Lift retaining nut (3) into position on stud (2) and tighten.

D. Test
Carry out operational test of Enhanced Ground Proximity Warning System (Ref. 34-48-00, P. Block 501).

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

R Post SB 34-2206 For A/C 101-200,

E. If the Enhanced GPWS has not the last updated database, upload the PCMCIA card database (Ref. 34-48-00, P. Block 301).

**ON A/C ALL

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.

**ON A/C 101-200,

Post SB 34-2188 For A/C 101-200,

R Post SB 34-2206 For A/C 101-200,

F. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.

DME - DESCRIPTION AND OPERATION

1. General

The DME system is a medium range radio navigation aid. The aircraft is equipped with two DME systems capable of operating in the frequency range from 978 MHz to 1213 MHz.

The system provides the crew with:

- a digital readout of the slant range distance from the aircraft to a selected ground station.
- audio signals which identify the selected ground station.

2. Component Location

**ON A/C 001-100,

(Ref. Fig. 001)

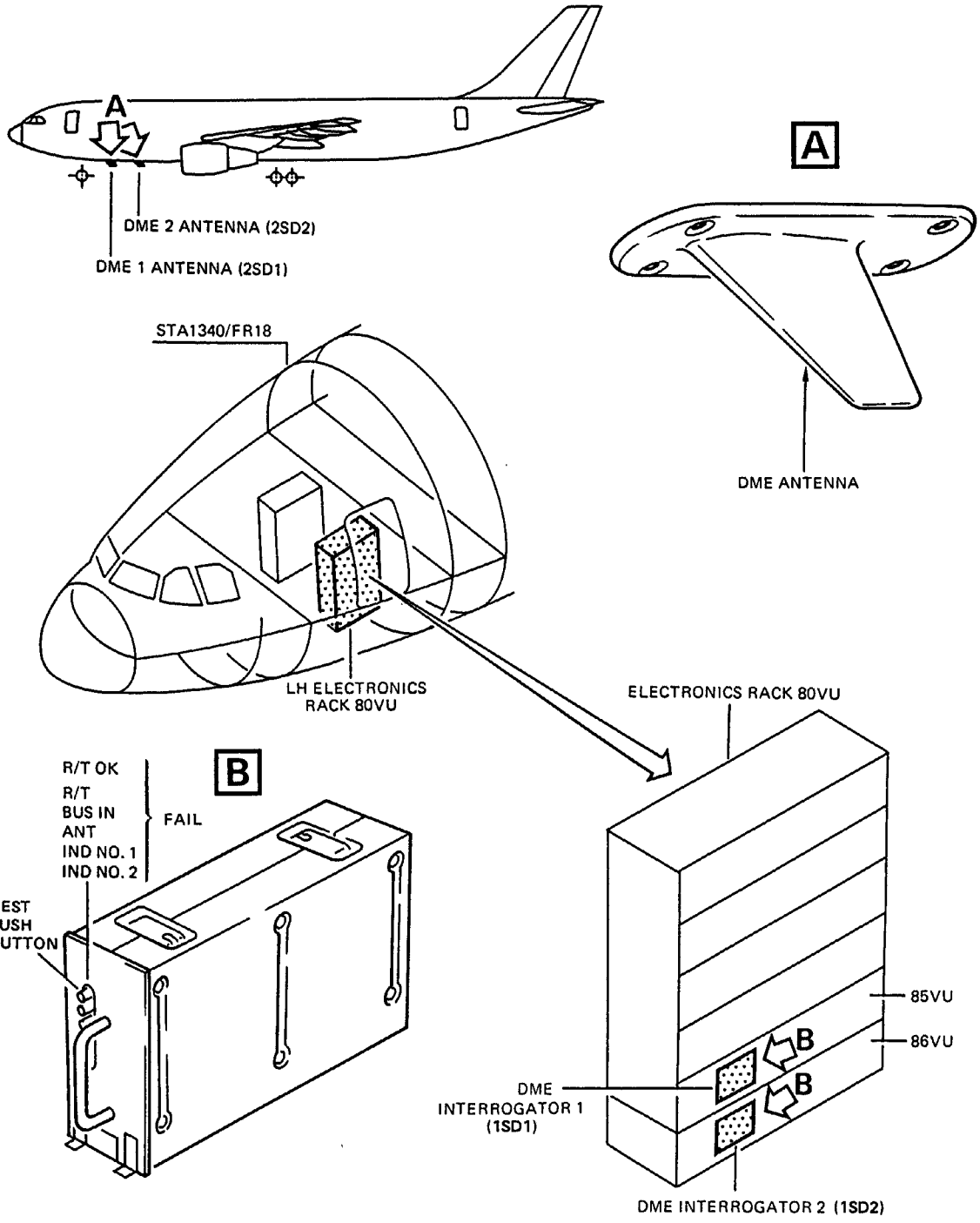
**ON A/C 101-200,

(Ref. Fig. 002)

**ON A/C ALL

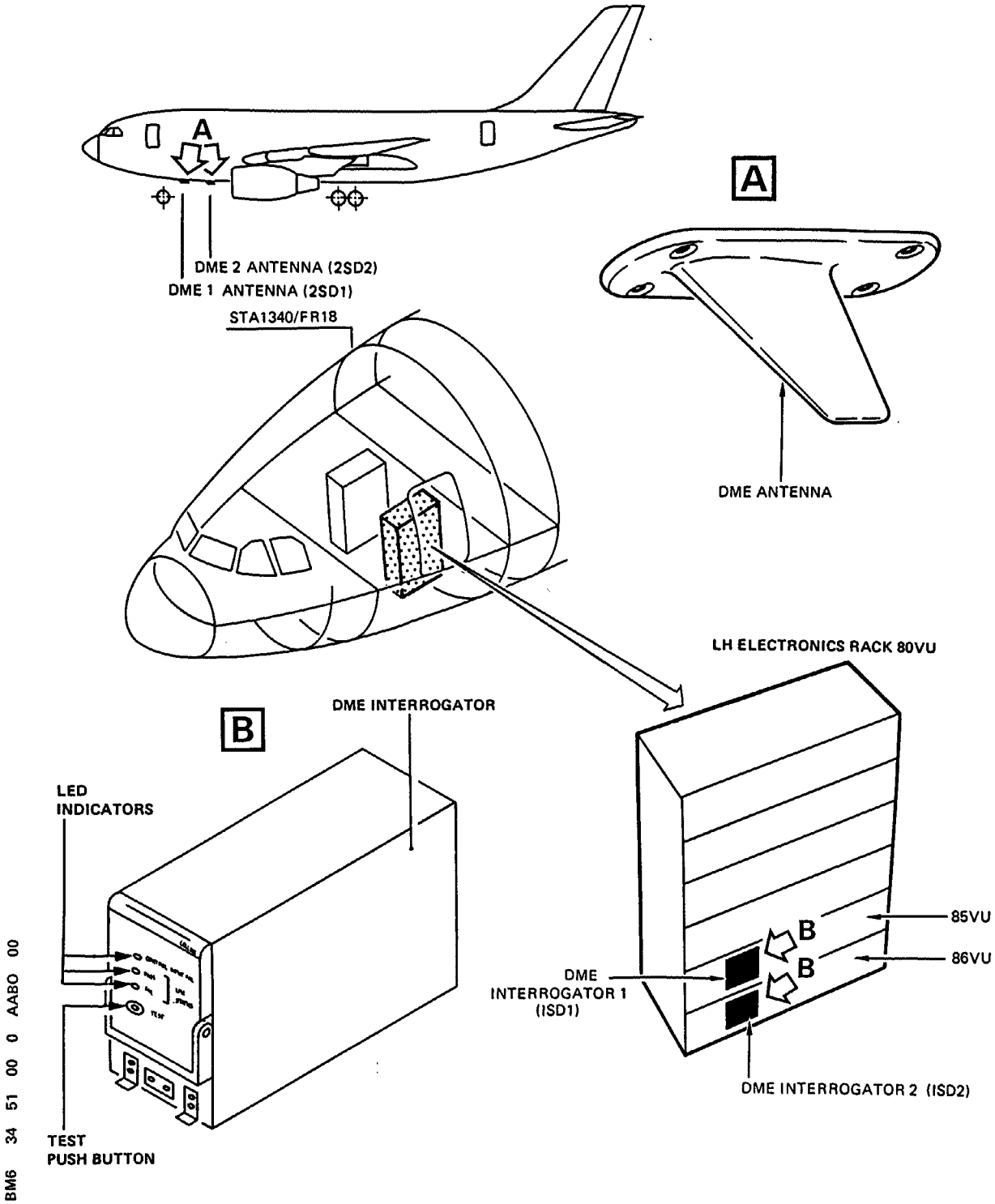
(Ref. Fig. 003)

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
	DME SYSTEM:				
1SD1	INTERROGATOR - DME 1	85VU	121		34-51-33
1SD2	INTERROGATOR - DME 2	86VU	121		34-51-33
2SD1	ANTENNA - DME 1		130		34-51-11
2SD2	ANTENNA - DME 2		130		34-51-11
23SD1	DME 1 TEST BUTTON	470VU	222		
23SD2	DME 2 TEST BUTTON	470VU	222		
	ASSOCIATED SYSTEMS:				
3RS1	VOR/DME CONTROL UNIT 1	8VU	211		
3RS2	VOR/DME CONTROL UNIT 2	8VU	212		
10FN1	DDRMI 1	3VU	211		
10FN2	DDRMI 2	5VU	212		
33FN1	VOR/NAV/ILS SWITCH	413VU	211		
33FN2	VOR/NAV/ILS SWITCH	412VU	212		
143GB	AIR/GROUND RELAY	83VU	121		
44GB	AIR/GROUND RELAY	104VU	121		



BM6 34 51 00 0 AAAO 00

DME - Component Location
Electronics Compartment
Figure 001



DME - Component Location
Electronics Compartment
Figure 002

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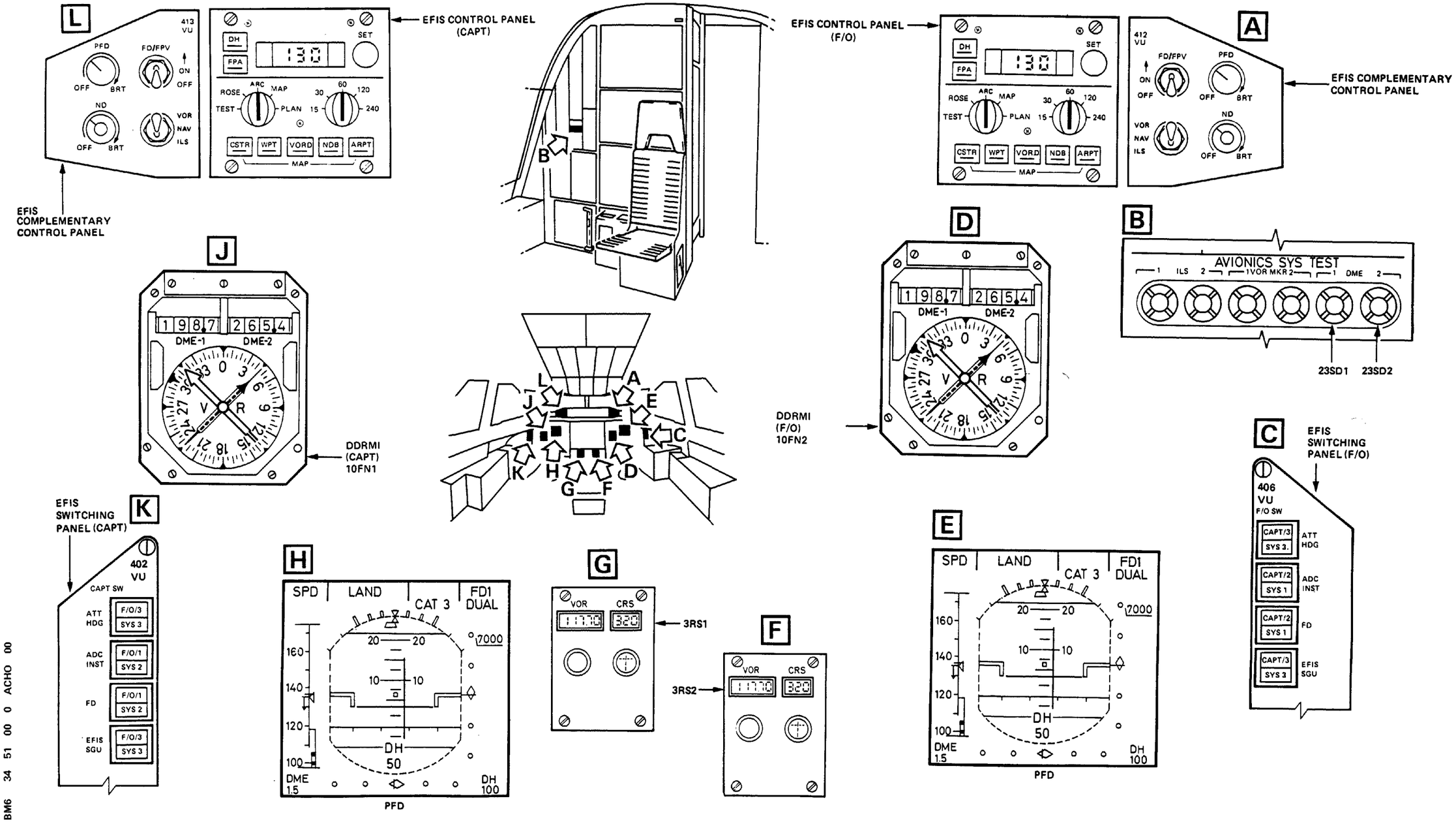


DME - Component Location
Flight Crew Compartment
Figure 003

NOTE: For system components which are mentioned but not described in detail, please refer to:

Audio Integrating Sys.	(Ref. 23-50-00)
Instr.! Pnl.Int.Light	(Ref. 33-13-00)
FMC	(Ref. 34-60-00)
DDRMIs	(Ref. 34-29-00)
EFIS	(Ref. 34-70-00)

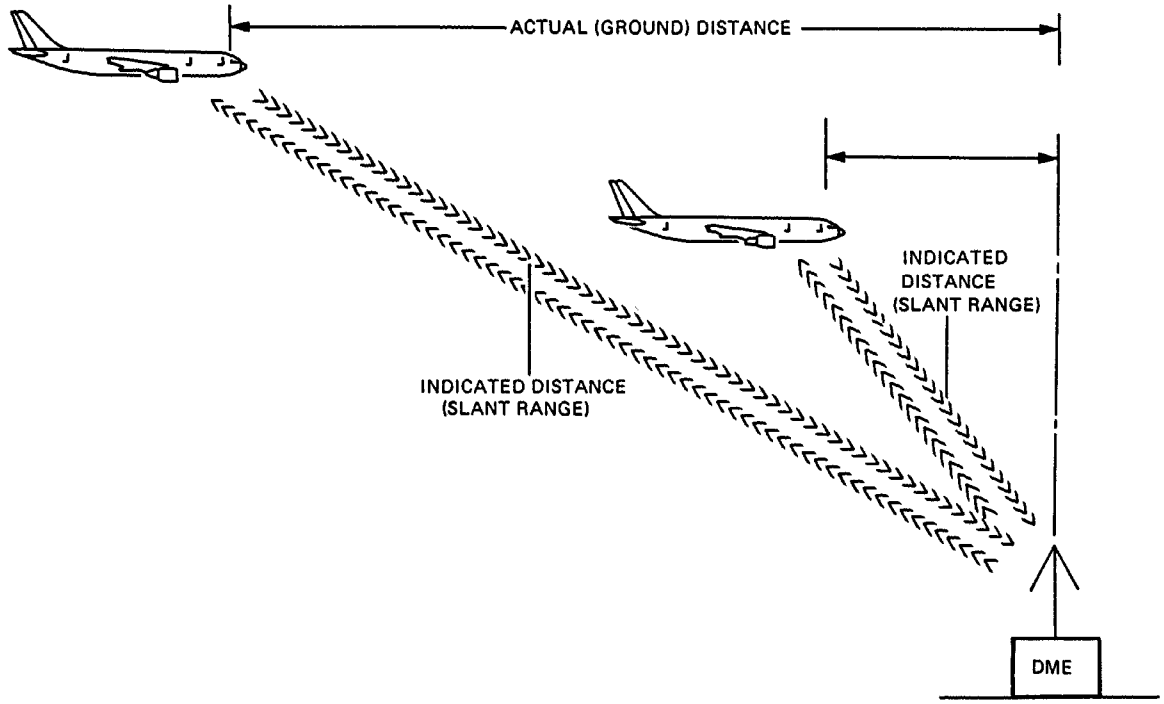
3. System Description

A. Principle (Ref. Fig. 004, 005)
The principle of DME navigation is based on transmission time measurements. Pairs of interrogation pulses are sent at a random rate from an onboard interrogator to a DME ground station. After a defined delay (50 micros in X mode and 56 micros in Y mode) this ground station transmits the received signal by using another RF carrier. The onboard interrogator receives this reply signal. The time between transmission and reception represents the distance between aircraft and ground station.
The inquiry signals from the airborne equipment are paired pulses of a defined spacing, but the distance between two pairs varies from one transmission to the next. This principle allows the interrogator to find out its own pulses among many other pulses which are replies for other aircraft.
The ground station can handle approx. 100 aircraft.
The interrogation frequencies vary from 1025 MHz to 1150 MHz; the reply frequencies from 962 MHz to 1213 MHz.
The ground station identifies itself by sending a morse signal.

B. System Architecture
The aircraft is equipped with two independent DME systems which can be used simultaneously.
In each system the DME interrogator is connected to:
- DME antenna
- VOR/DME Control Unit
- DDRMIs (one each for CAPT and F/O)
- Audio Integrating System
- AVIONIC SYSTEM TEST Panel
- FMS
- other DME system and both ATCRBS systems
- AIR/GROUND (Relay) switch
- VOR/NAV/ILS switch

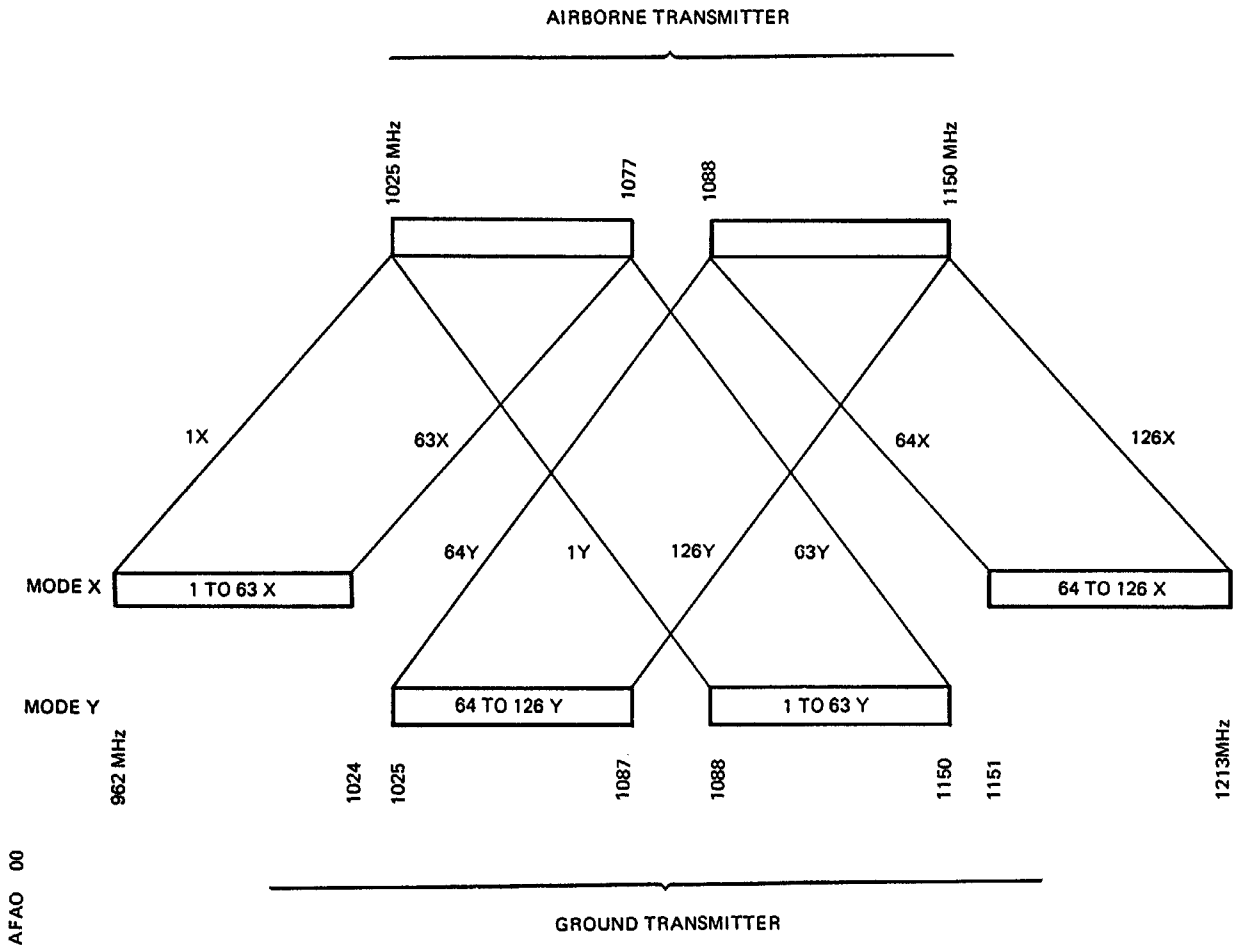
The control unit provides digital frequency data to tune the transmitter and receiver part of the interrogator.
The DME interrogator can also be tuned by the FMC. The FMC tunes the DME frequency, if the VOR/NAV/ILS switch is in NAV or ILS position.
The interrogator data output is connected to the DDRMIs and the FMCs.
The interrogator audio output supplies the Audio Integrating System with the related DME morse identification signal from the ground station. This signal can be heard in the headsets and/or loudspeaker, when the VOR/NAV/ILS switch is in either VOR or ILS position.
The test circuit activates the DME BITE to produce outputs for the DDRMIs, and the FMCs.
The connection between all DME and ATCRBS systems (suppression line) ensures that all other systems are suppressed when one system is transmitting.
(Ref. Fig. 006)

R C. Power Supply (Ref. Fig. 007)
The DME systems are supplied with 115 V AC, 400 Hz.
R -DME Interrogator 1 is supplied by normal busbar 304XP via circuit



BM6 34 51 00 0 AEAO 00

DME - System Principle
Figure 004



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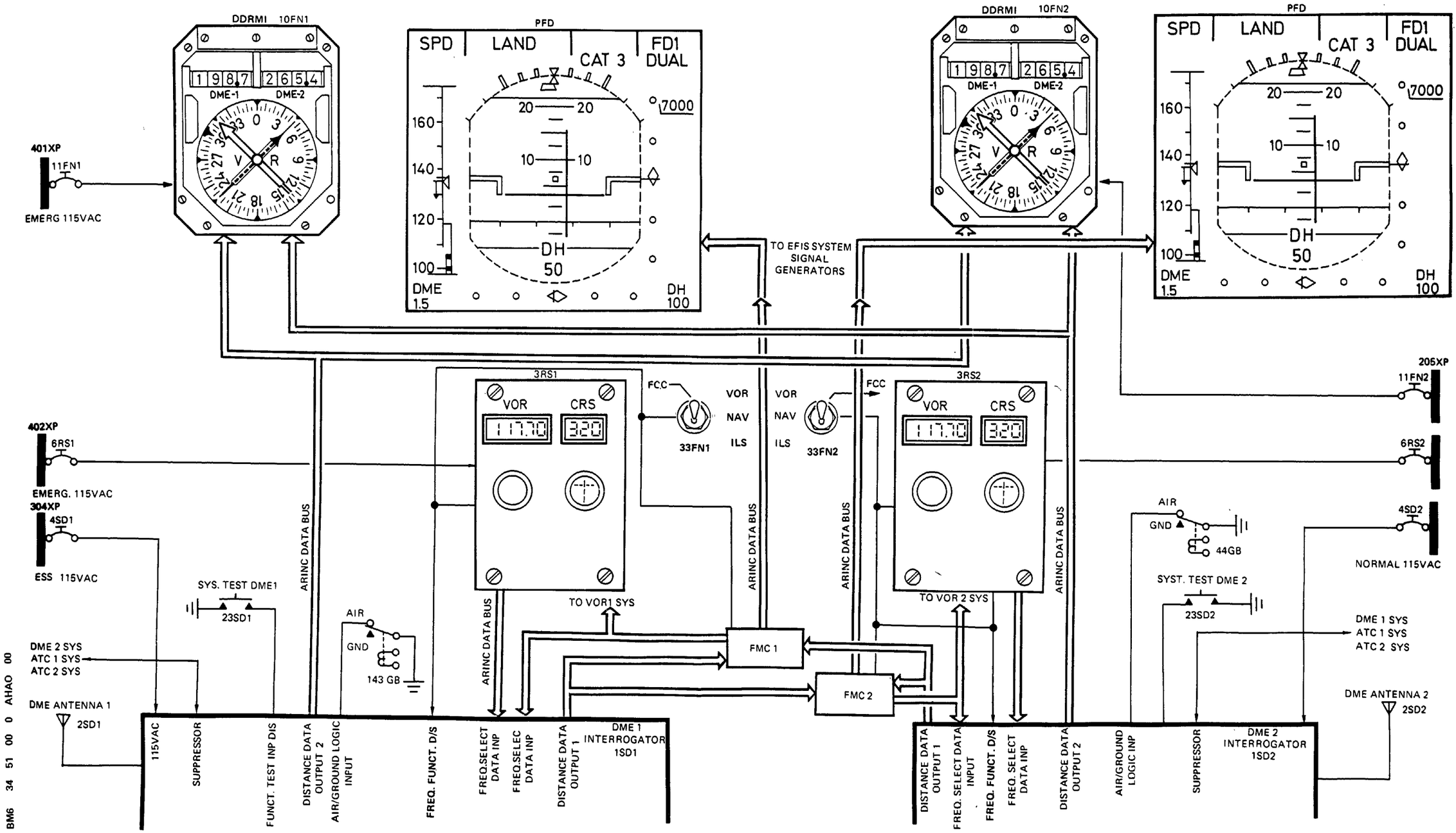
DME - Frequency Allocation
Figure 005

R EFFECTIVITY: ALL

PIA



DME - System Architecture
Figure 006

breaker 4SD1.
-DME Interrogator 2 is supplied by normal busbar 205XP via circuit breaker 4SD2.
R -DDRMI 1 is supplied by emergency busbar 401XP via circuit breaker 11FN1.
-DDRMI 2 is supplied by normal busbar 205XP via circuit breaker 11FN2.
-VOR/DME control units are supplied via the VOR system.
(Ref. Fig. 007)

R **ON A/C 001-100,

4. Component Description

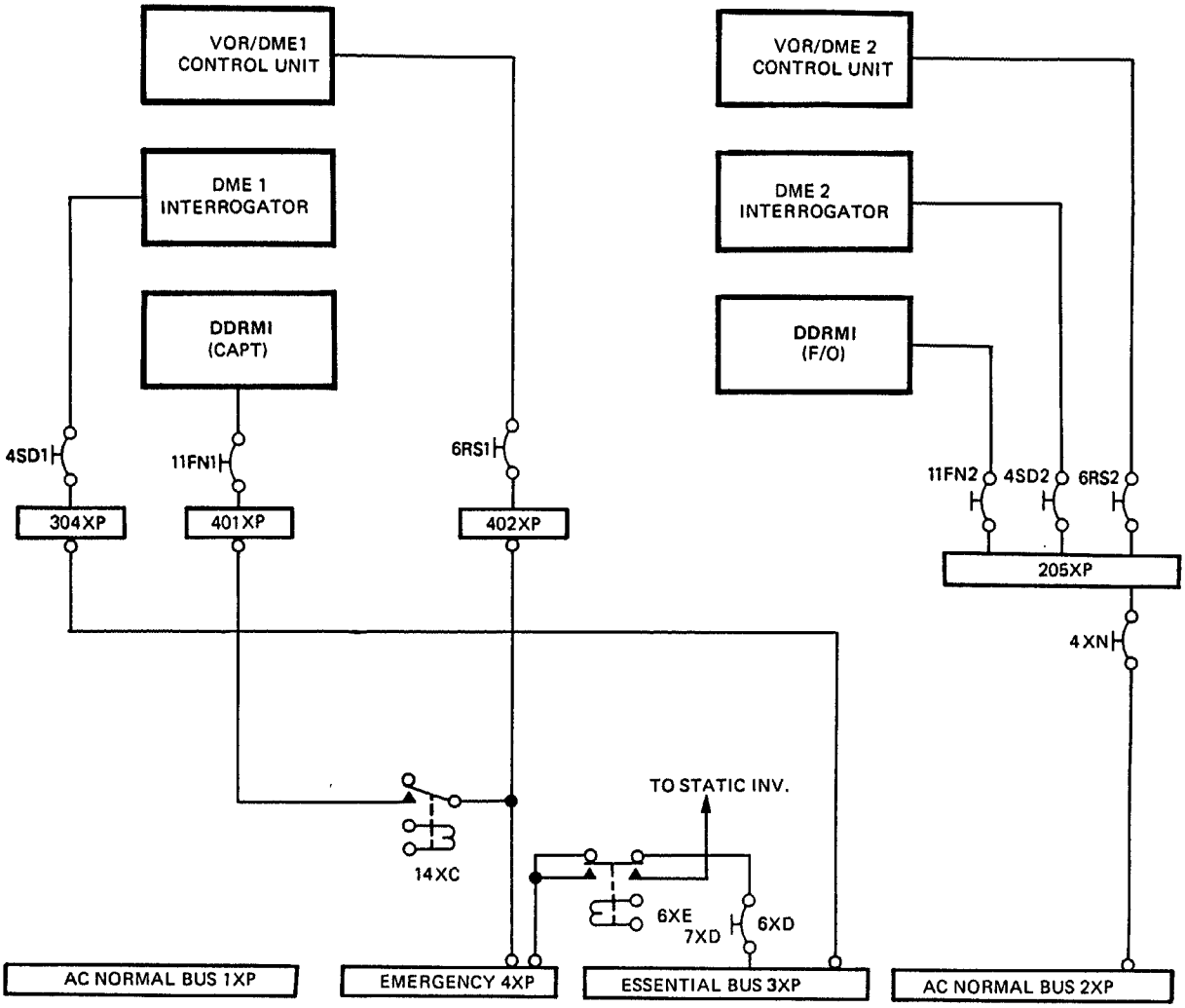
A. DME Interrogator
(1)Description (Ref. Fig. 008)
The front panel of the interrogator is fitted with:
- a test push-button
- six indicator lights, which indicate test procedure results:
  - R/T OK (green), indicates correct DME function
  - R/T FAIL (red), indicates failure of DME function
  - BUS IN FAIL (yellow), indicates invalid input on the selected port of the interrogator
  - ANT FAIL (yellow), indicates that the antenna is incorrectly connected or has failed
  - IND NO 1 FAIL (yellow), indicates failure of indicator No 1
  - IND NO 2 FAIL (yellow), indicates failure of indicator No 2.

The major parts of the DME interrogator are:
- the microwave unit, which consists of
  - CW source and synthesizer
  - test oscillator
  - pulse amplifier
  - reception amplifier and mixer, and
  - the duplexer
- the IF amplifier 63 MHz
- the processing board, which is the primary controlling element of the DME
- the input/output board
- the power supply unit.

R **ON A/C 101-200,

4. Component Description

A. DME Interrogator
(1)Description (Ref. Fig. 010)
The front panel of the interrogator is fitted with:
- a test push-button
- three indicator lights, which indicate test procedure results:
- CONTROL INPUT FAIL indicates incorrect repetition rate, sign-status



BM6 34 51 00 0 ALAO 00

DME - Power Supply
Figure 007

matrix, parity of the ARINC 429 input control words
- LRU STATUS-PASS indicates correct internal status of the DME
- LRU STATUS-FAIL indicates incorrect internal status of the DME

The major parts of the DME interrogator are:
- the chassis assembly: it contains a circulator, a low-pass filter assembly, and the interconnect wiring between the cards, modules and the rear connectors.
- the power supply assembly, which converts the 115 V, 400 Hz aircraft power into the DC voltage necessary for DME operation.
- the synthesizer assembly, which generates the L-band frequency.
- the driver assembly: which modulates and amplifies the L-band
R signal from the synthesizer, applying a pulsed RF output signal to the power amplifier and a continuous wave drive signal to the receiver.
- the power amplifier assembly, which amplifies and shapes the RF pulses from the driver and applies them to the antenna.
- the receiver assembly, which selects, amplifies, and detects the ground-to-air signals by means of several filters, amplifiers, mixers and video detectors.
- the video processor, which decodes the IF video output from the receiver, controls the receiver IF gain, tunes the receiver, interfaces with ARINC buses, and provides the audio ident signal.
R - the range processor, which consists of a CPU, memory circuits, transmitter pulse-pair encoder, a self-test generator, a control bus interface and a range counter network that includes a range
R clock. The CPU is a primary controlling element in the DME. It tunes the synthesizer, initiates ground station interrogation, computes the range and controls the pulse-pair decoding, IF AGC, ARINC-429 interface, monitor and self-test functions.
- the monitor assembly, which provides a means of detecting faults within the DME. The monitor circuit consists of a fault monitoring circuit, a non-volatile memory, an I/O circuit and the DME front panel self-test switch and fault indicators.

R **ON A/C 001-100,

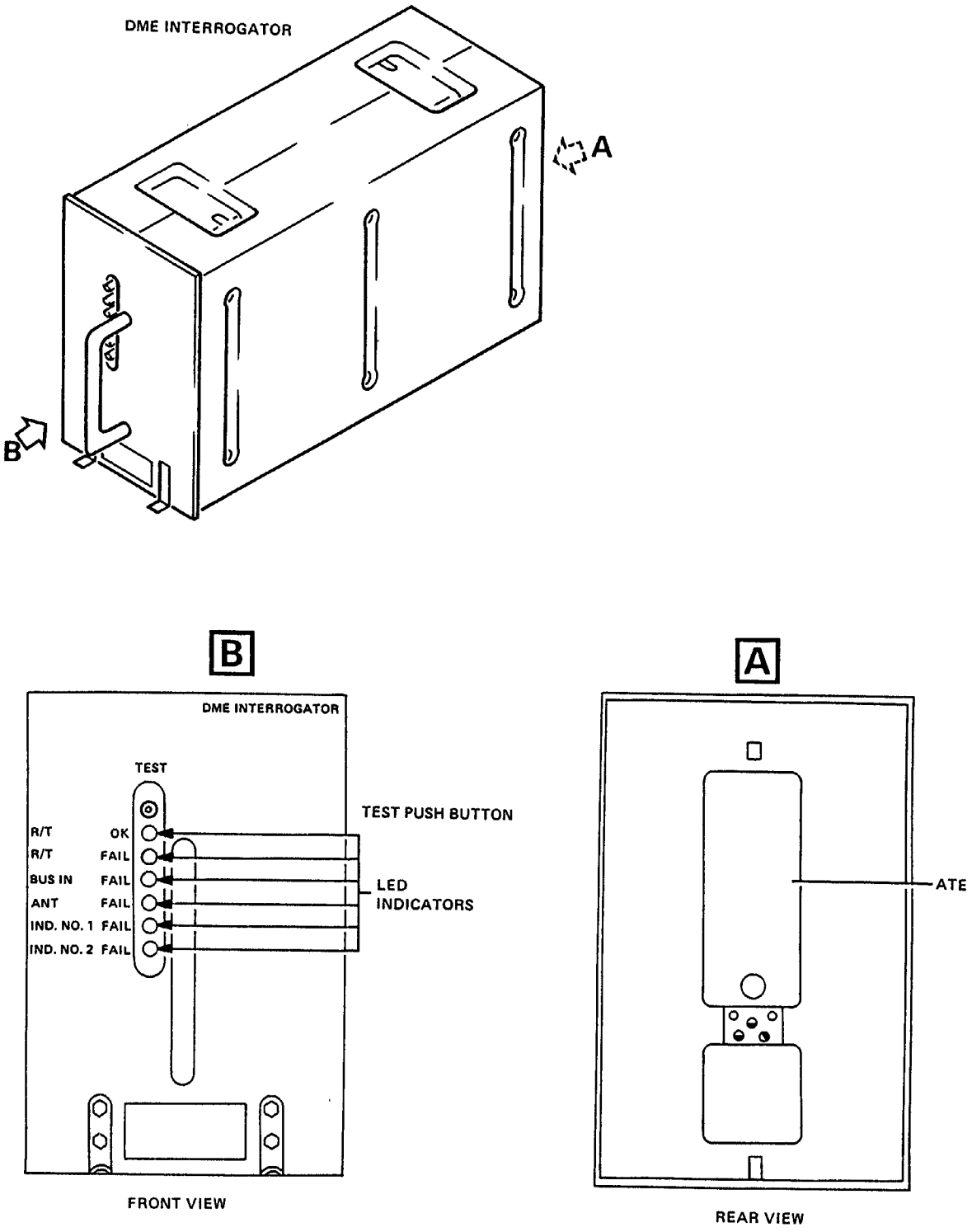
(Ref. Fig. 008)
(Ref. Fig. 009)

R **ON A/C 101-200,

(Ref. Fig. 010)
(Ref. Fig. 011)

R **ON A/C 001-100,

(2)Basic operation
- Interrogation
When the frequency for a DME ground station is selected on the VOR/DME control unit or by the FMC, a serial digital tuning word is transmitted along an ARINC 429 data bus to the micro-



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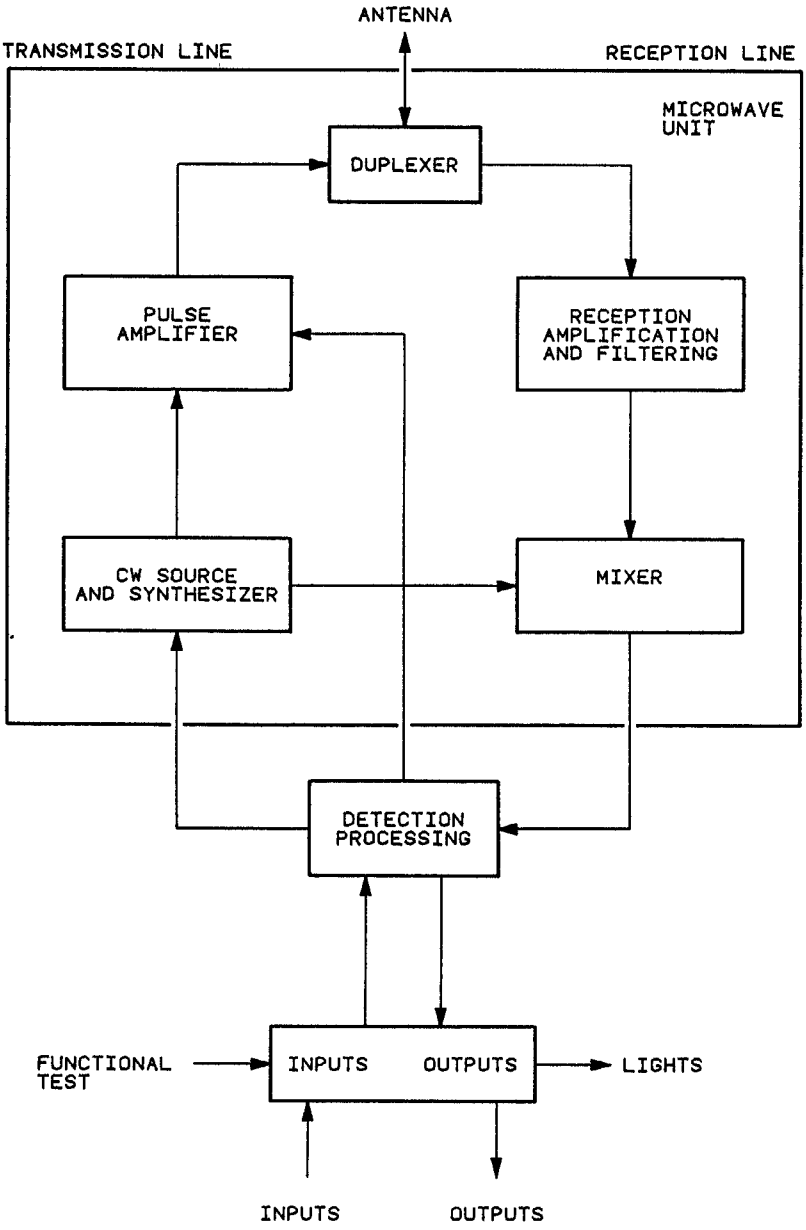
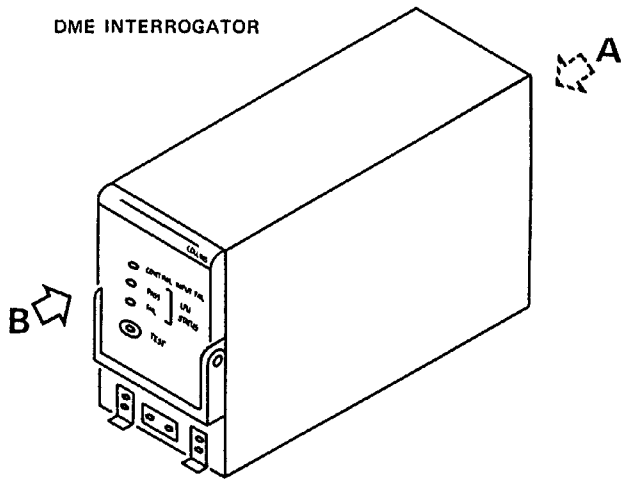
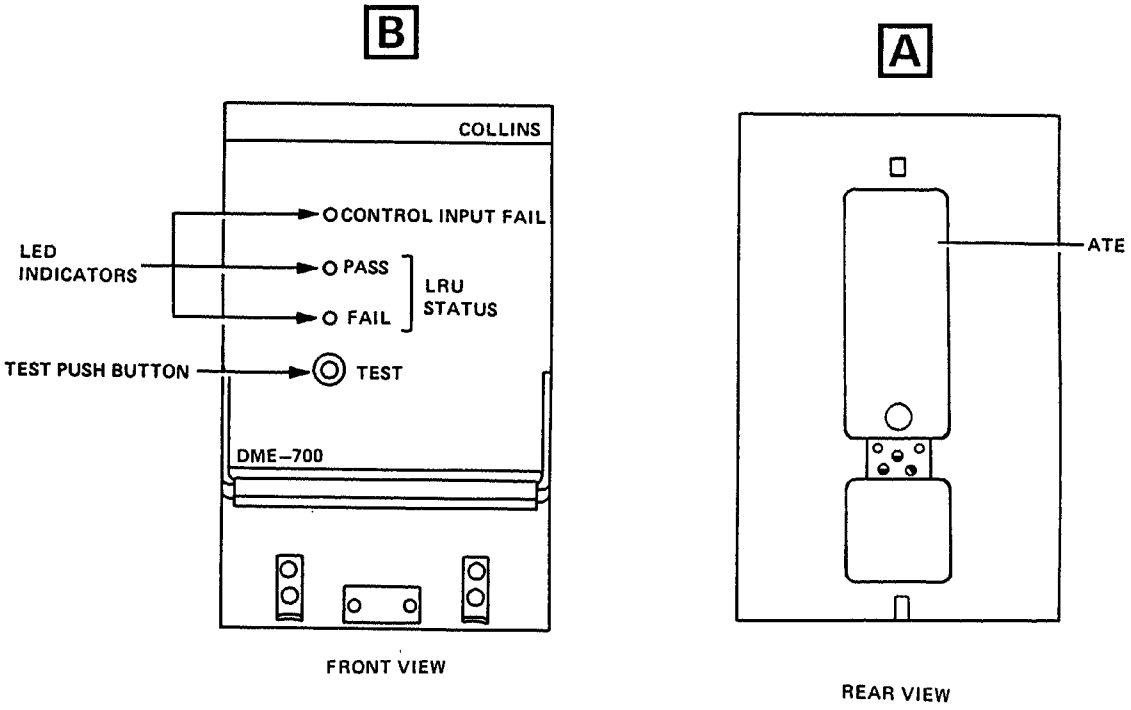
DME - Interrogator
Figure 008



B M 6 34 51 00 0 APA0 00

DME - Interrogator Block Diagram
Figure 009





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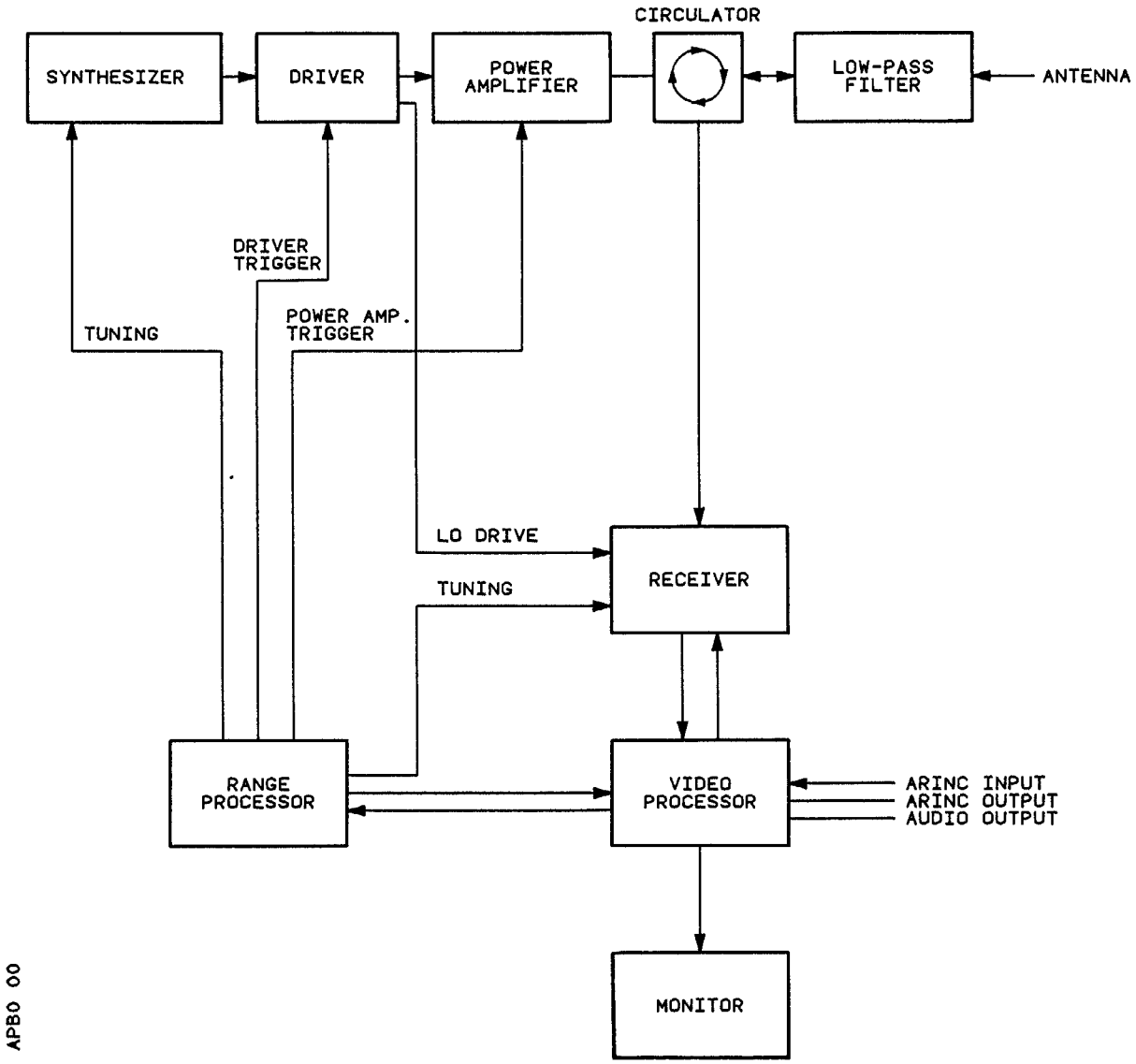
DME - Interrogator
Figure 010



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DME - Interrogator Block Diagram
Figure 011

processor in the interrogator. The microprocessor uses the frequency data to provide a tuning word for the synthesizer. In the synthesizer the VCO, which operates in the L-band range of 1025 to 1150 MHz, generates the transmitter signal which after amplification is applied to the pulse amplifier. The frequency of the VCO is controlled by the SMO circuit which locks on to the selected frequency. The synthesizer output is pulse modulated in the pulse amplifier, amplified to 700 W, and applied through the duplexer to the antenna. The pulse modulation trigger signals are provided by the processing board.

- Reply signal processing
  Reply pulses from a DME ground station are received by the antenna and applied through the duplexer to the reception line. In the reception amplifier and mixer the reply pulses are filtered, amplified and mixed with the continuous wave signal from the synthesizer to produce a 63 MHz IF signal, which is delivered to the IF amplifier. In the IF amplifier the signal is further amplified, filtered and mixed with a local 52.3 MHz signal to produce a 10.7 MHz IF signal. The detected valid IF signals are supplied to the input/output board. The input/output board verifies that valid reply signals have been received. In this case the microprocessor on the processing board starts distance calculation. If requested the microprocessor also imposes the input/output board to produce an audio identification signal.
- Distance measurement
  Distance measurement is made by converting the time delay between interrogation signal transmission and reply signal reception. Calculated distance values are stored in the memory. During an interrogation cycle additional reply pulse delay measurements are made and processed to produce an accurate range distance. The range distance data is transmitted through ARINC 429 data ports to the DDRMI and the FMC.

(3)Modes of operation

- The standby mode occurs at initial turn-on and the DME reverts to standby mode when ground station reply pulses are absent. In this mode the DME produces no interrogation pulses and NCD appears on the DDRMI. Receiving ground station squitter pulses again causes the DME to try to communicate with the ground station and to compute distance data.
- Directed mode: In this mode the DME is directed to interrogate from one to five stations. If the VOR/NAV/ILS switch is in NAV or ILS position these directed stations are selected from the FMC. If the flight crew requires distance information for a particular station, the crew can request it according to the VOR/NAV/ILS switch. If the VOR/NAV/ILS switch is in VOR position, the station is determined by selecting a DME/VOR frequency on the VOR/DME control unit; if in NAV position, the station is determined through the FMC CDU page; if in ILS position, the station is determined by selecting a DME/ILS frequency on the ILS control panel. The DME is then directed to output display distance information for the station. Only one station can be selected for display. If none of the directed stations are selected for display, NCD is indicated on the DDRMI to prevent it from indicating false information, and the FMC is supplied with valid distance data.
- Free scanning mode: In this mode the DME provides distance information for all stations that are in DME range.

The DME divides the 252 DME channels into a foreground and a background loop. The foreground loop consists of five stations, any or all of which can be designated by the FMS. If less than five stations are designated, the DME fills the empty slots with the closest stations. Distance data for the five foreground stations is provided sequentially.
The background loop consists of the other 247 stations. The DME scans the background loop, searching for station reply signals. If the DME receives reply signals at a significant rate, distance is calculated, and the distance data is provided to the FMC. Distance data for background stations is provided punctually.
When in free scanning mode, one station can be selected by the crew as a displayed station. In this case the requested station is placed in the free scan foreground loop. If none of the directed frequencies is selected as a displayed station, NCD is indicated in the DDRMI to prevent it from indicating false information, and the FMC is provided with valid distance data
If the reply pulses of a directed station or a free scan foreground station are lost the DME operates in memory mode for approximately 10 seconds or until reply signals are received, whichever is the shorter time. The distance is then calculated from the most recent distance data stored in memory. Assuming no acceleration of the aircraft, the DME outputs continue to change at approximately at the same rate at which they where changing just prior to the memory period.
Interrogation of a requested station takes priority over all other stations, and interrogation of foreground stations takes priority over background stations. So the DME provides distance data for the displayed station if requested at the highest rate and distance data for background stations if available at the lowest rate.

(4)Monitoring

The monitoring system (BITE) allows the detection of performance degradation and sets the status bits for the DME distance message.
The BITE monitors:
- receiver gain
- CPU memory circuit
- power amplifier output
- SMO frequency locking
- range counting
- pulse decoding
- distance calculations.

When any failure is detected, the BITE system sets the ''Failure warning'' code to be delivered to the FMCs and to the respective displays.
In addition the failure information is stored in the internal non volatile memory for future fault isolation.

(5)Suppression

R The DME and ATC (and TCAS if available) systems operate in the same
R L-band frequency range. To prevent intersystem interference only one
R system is allowed to receive at any one time. When a DME interrogator
R (or an ATC transponder or a TCAS if available) is transmitting, an

R external suppression signal is supplied by the transmitting system to
R all other systems to interrupt reception of the other systems.

(6)Arinc 429 Communication

The interrogator receives and transmits 32-bit serial words through the ARINC 429 digital information transfer system. The parameters related to the DME are:

parameter	label (octal)
DME binary distance	201
DME BCD distance	202
DME frequency	035

NOTE : ''DME frequencies'' supplied to and delivered from the DME are actually the VOR, COM, or MLS frequencies paired with the DME L-band channel number per ICAO Annex 10.

For further information refer to ARINC Characteristic 709, ''Airborne Distance Measuring Equipment''.

**ON A/C 101-200,

(2)Basic operation

- Interrogation

When the frequency for a DME ground station is selected on the VOR/DME control unit or by the FMC, a serial digital tuning word is transmitted along an ARINC 429 data bus to the range processor in the interrogator. The range processor uses the frequency data to provide a tuning word for the synthesizer. In the synthesizer the VCO, which operates in the L-band range of 1025 to 1150 MHz, generates the transmitter signal which after amplification is applied to the driver. The frequency of the VCO is controlled by the SMO circuit which locks on to the selected frequency. The synthesizer output is pulse modulated in the driver, amplified to 75 W and applied to the power amplifier. The range processor provides the trigger signals for the driver modulator. The driver also provides a local oscillation for the first mixer in the receiver. In the power amplifier the pulses from the driver are shaped and amplified to a nominal 500W. The amplified pulses are then transmitted through a circulator and a low-pass filter to the antenna to interrogate the ground station.

- Reply signal processing

Reply pulses from a DME ground station are received by the antenna and applied through the circulator to the receiver. In the receiver the reply pulses are filtered, amplified and mixed with the local oscillation from the driver to produce a 63 MHz IF signal. After further amplification and filtering, a second mixer combines the 63 MHz signal with a local 52.3 MHz oscillation to produce a 10.7 MHz IF signal which is applied to the video processor through a video detector. In the video processor the signal is applied to a threshold detector and a pulse pair decoder. The threshold detector determines the range measurement timing. The decoder verifies that a valid pulse is received and applies the valid video pulse to the range processor.

An audio identification circuit in the video processor decodes and amplifies the identification signal transmitted by the DME ground station and provides an output to the audio system in the aircraft.

- Distance measurement
  A range counter in the range processor, which generates the driver and power amplifier trigger pulses, measures the time interval between the first interrogation pulse and the receipt of the first valid video pulse. The time delay of the reply pulse is converted to a distance
R value and stored in the memory. During an interrogation cycle, additional reply pulse delay measurements are made and processed to produce an accurate range distance. The range distance data is transmitted through ARINC 429 data ports to the DDRMI and the FMC.

(3)Modes of operation

- The standby mode occurs at initial turn-on and the DME reverts to standby mode when ground station reply pulses are absent. In this mode the DME produces no interrogation pulses and NCD appears on the DDRMI. Receiving ground station squitter pulses again causes the DME to try to communicate with the ground station and to compute distance data.
- Directed mode: In this mode the DME is directed to interrogate
R from one to five stations. If the VOR/NAV/ILS switch is in NAV or ILS position these directed stations are selected from the FMC. If
R the flight crew requires distance information for a particular station, the crew can request it according to the VOR/NAV/ILS switch. If the VOR/NAV/ILS switch is in VOR position, the station is determined by selecting a DME/VOR frequency on the VOR/DME control unit; if in NAV position the station is determined through the FMC CDU page; if in ILS position the station is determined by selecting a DME/ILS frequency on the ILS control panel. The DME is then directed to output display distance information for that station. Only one station can be selected for display. If none of the directed stations is selected for display, NCD is indicated on the DDRMI to prevent it from indicating false information, and the FMC is supplied with valid distance data.
- Free scanning mode: In this mode the DME provides distance information for all stations that are in DME range.
  The DME divides the 252 DME channels into a foreground and a background loop. The foreground loop consists of five stations, any or all of which can be designated by the FMS. If less than five stations are designated, the DME fills the empty slots with the closest stations. Distance data for the five foreground stations is provided sequentially.
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If the reply pulses of a directed station or a free scan foreground station are lost the DME operates in memory mode for approximately 10 seconds or until reply signals are received, whichever is the shorter time. The distance is then calculated from the most recent distance data stored in the memory. Assuming no acceleration of the aircraft, the DME outputs continue to change at approximate at the same rate at which they where changing just prior to the memory period.
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The BITE monitors:

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- power amplifier output
- SMO frequency locking
- range counting
- pulse decoding
- distance calculations.

When any failure is detected the BITE system sets the ''failure warning'' code to be delivered to the FMCs and to the respective displays.
In addition the failure information is stored in the internal non volatile memory for future fault isolation.

(5)Suppression

R The DME and ATC (and TCAS if available) systems operate in the same
R L-band frequency range. To prevent intersystem interference only one
R system is allowed to receive at any one time. When a DME interrogator
R (or an ATC transponder or a TCAS if available) is transmitting, an
R external suppression signal is supplied by the transmitting system to
R all other systems to interrupt reception of the other systems.

(6)Arinc 429 Communication

The interrogator receives and transmits 32-bit serial words through the ARINC 429 digital information transfer system. The parameter related to the DME are:

parameter	label (octal)
DME binary distance	201
DME BCD distance	202
DME frequency	035

NOTE : ''DME frequencies'' supplied to and delivered from the

DME are actually the VOR, COM, or MLS frequencies paired with the DME L-band channel number as per ICAO Annex 10.
For further information refer to ARINC Characteristic 709, ''Airborne Distance Measuring Equipment''.

R **ON A/C ALL

B. VOR/DME Control Unit (Ref. Fig. 012, 013)
(1)Description:
The dual purpose control panel, used by the VOR system and the DME system, enables the selection of the VOR/DME ground station and the tuning of the DME interrogator. DME channels are paired with VOR and ILS frequencies.
The front panel of the control unit features:
- a VOR window in which the corresponding VOR or ILS paired frequency is displayed in steps of 50 kHz.
- a frequency control selector with inner and outer concentric knobs. The inner knob controls the fractions of MHz and the outer knob controls the tens and units of MHz.
- a CRS window in which the selected course is displayed in steps of 1°.
- a course control selector which enables the selection of a course from 0° to 360°.

The displays use LCD indicators associated to opto-electronic incremental encoders which are driven by the control knobs. The stable positions of the encoders are locked by a mechanical pawl.
The control unit is illuminated by the 5 V instrument panel integral lighting system (Ref. 33-13-00).
(2)Operation:
The incremental encoders are made up of an opto-electronic assembly designed to impose logic states on its output wires according to its position.
The dotted vertical lines represent the stable reading positions. If the stable position 1 is taken as reference zero, wires A and B are at state 00. If the knob is turned in the direction of the arrow, the following states are obtained:

Wire A	Wire B	
0	0	State 1
1	0	
1	1	
0	1	

If the knob is turned in the reverse direction (decrementation), the following states are obtained:

Wire A	Wire B	
0	0	State 1
0	1	
1	1	

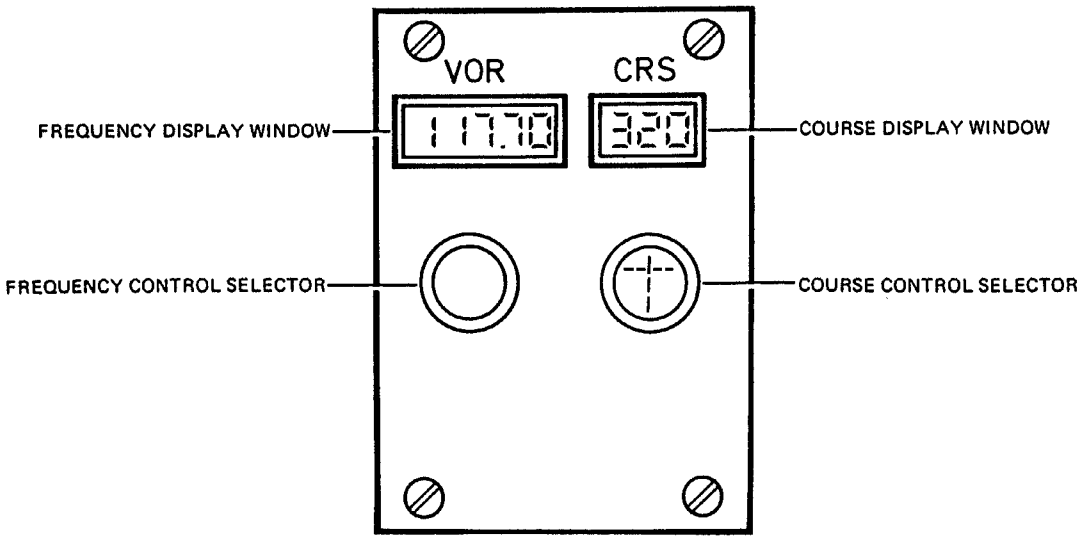
Reading the successive states of the wires A and B indicates the direction of rotation of the knobs and the number of steps.
The processing unit periodically scans the inputs of the incremental encoders to define their states. If the course knob is incremental, the processing unit detects the change of state and the course value previously stored is updated.
A message is calculated according to the data stored in the memory of the processing unit. Once the message is organized, it is fed to the logic ARINC transmitter which transmits the ARINC compatible message to the ARINC receiver.
The processing unit reads the received word and compares it to the transmitted word. If they are not identical, a FLAG signal is sent to the display to block the ARINC transmitter. If they are identical, the value received through the ARINC receiver is displayed and the ARINC transmitter is enabled. Transmission on the ARINC line is then performed.
There are four codes for course and frequency messages. These comply with ARINC 429, and are sent to the bus:
- Label 034, VOR frequency
- Label 035, DME frequency
- Label 024, BCD course
- Label 100, BNR course.

C. Antenna (Ref. Fig. 014)
The L band antenna is a short stub, all aluminum, blade-type antenna which operates in the 960 MHz frequency band. It is vertically polarized, has an impedance of 50 Ohm and a VSWR of 1.42 : 1.
The antenna is grounded on the RF center conductor for use in self-test circuits.

5. System Operation

A. Energization
The DME interrogators are energized when the busbars are supplied with 115 V AC, 400 Hz and the DME 1 and/or DME 2 circuit breakers are closed. For the DME operation all other components related to the system such as DDRMIs, EFIS, FMS etc. must be energized.

B. Control
- Frequency Selection
The way of DME frequency selection depends on the VOR/NAV/ILS switch position.
If the VOR/NAV/ILS switch is in either NAV or ILS position, frequency selection is done by the DME itself (free scanning mode) or by the FMC. Since no action of the crew is required this is called the AUTOTUNE function. In this case an additional station is selected by the crew or otherwise by the FMC for display on the DDRMI, on the navigation display, and on the CDU ''PROGRESS'' page.
If the VOR/NAV/ILS switch is in VOR position, frequency selection is done through the VOR/DME control unit the selected station is used



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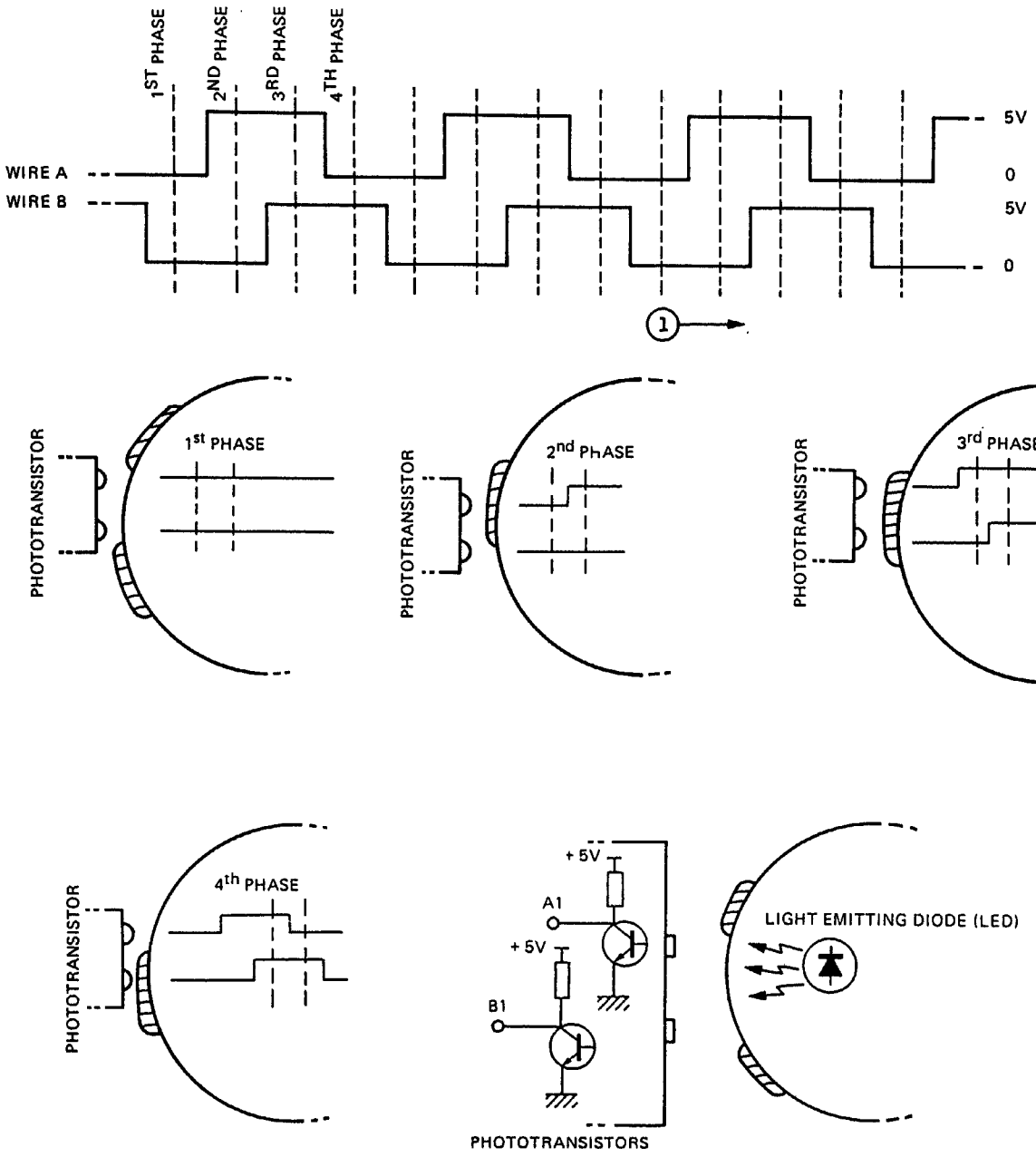
VOR/DME - Control Unit Frontface
Figure 012



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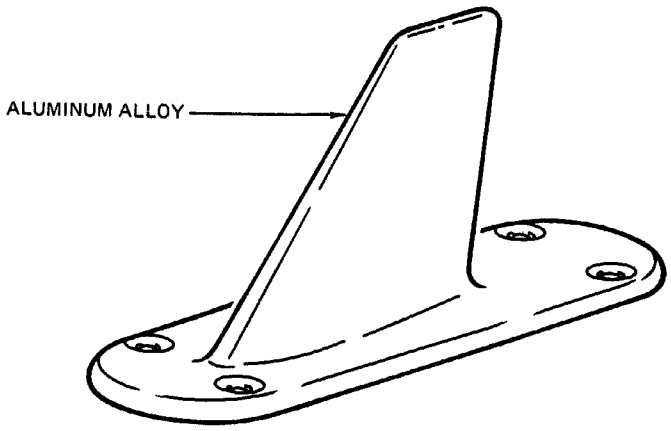
VOR/DME - Control Unit Signal Generation
Figure 013

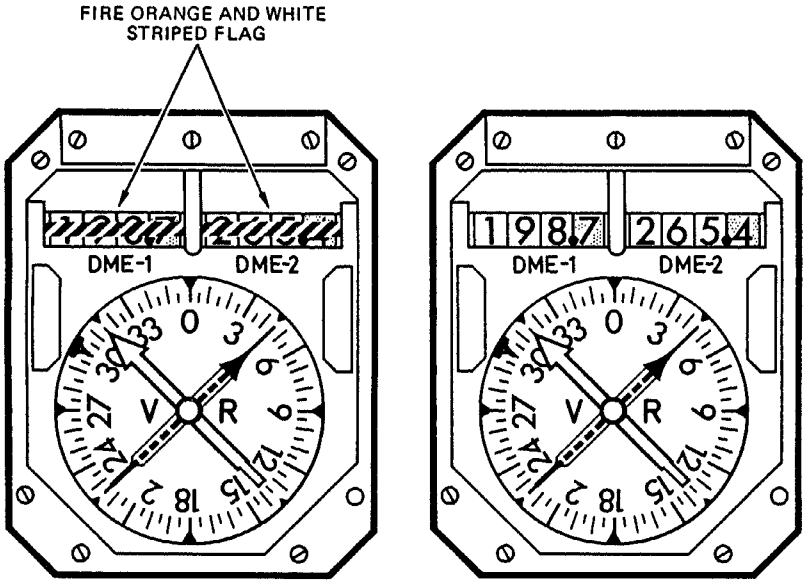


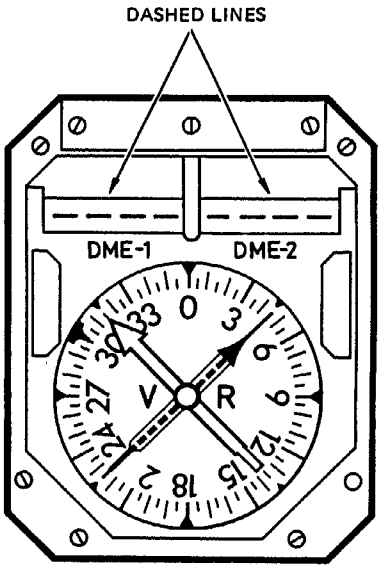
DME - Antenna
Figure 014

for display.
- VOR/DME frequency display
  Only the selected VOR frequency is displayed by means of Liquid Crystal Devices: if a VOR frequency of 108 MHz is displayed, the interrogator frequencies 1041 MHz for transmitting and 978 MHz for receiving are selected automatically. If no frequency has been manually selected or if the VOR/NAV/ILS switch is in either NAV or ILS position, dashes are displayed on the VOR/DME control unit. In case of the control unit failure the frequency display is switched off.
- ILS/DMEs are a special case in radio tuning. They can only be selected for display of the ILS/DME slant range distance on EFIS.
  With the VOR/NAV/ILS switch in ILS position and a valid frequency is being received from the ILS, the FMC checks to see if the frequency received from the ILS has associated with it one or more DMEs within 30 NM of the aircraft. It determines this by checking all ILS/DMEs in the data base with the received ILS frequency. If a single match is found and the VOR/ILS mode discrete bit is set to ILS, the DME frequency is selected for tuning. If a match is found with more than one ILS, additional information is needed to unambiguously determine the DME for tuning. This is provided by the destination runway. If there is a destination runway in the flight plan and the associated ILS has the same frequency as one of the ILS/DMEs found in the data base search and the VOR/ILS mode bit is set to ILS, then the ILS/DME frequency is selected for DME tuning and the distance is displayed on PFD.

C. Indication and Audio Control
The station that has been selected for display (automatically by the FMC or manually by the crew) is indicated on the DDRMIs if distance data is available.
For an out-of-range station dashed lines are indicated on the DDRMI instead of digits. In case of failure detected by DME or DDRMI internal monitoring, an orange and white striped flag blanks the corresponding display window.
If the VOR/NAV/ILS switch is in VOR position, a DME frequency has been selected on the VOR/DME control unit, and the DME station is not out of range, the DME station can be identified by the audible identification signal delivered by the Audio Intergrating System through the loudspeakers and/or headsets.
DME/ILS distance is displayed on the PFD, (but not on the DDRMI or the CDU ''PROGRESS'' page), if an ILS frequency is selected on the ILS control panel, a DME is associated to the selected ILS station and the respective VOR/NAV/ILS switch is in ILS position. In this case the DME/ILS station can be identified by the audible identification signal delivered by the Audio Integrating System through the loudspeakers and/or headsets.
If the VOR/NAV/ILS switch is in VOR position, DME/ILS distance cannot be displayed on the PFD, but if an ILS frequency has been selected on the VOR/DME control unit, the DME/ILS distance is indicated on the DDRMI.
(Ref. Fig. 015, 016)

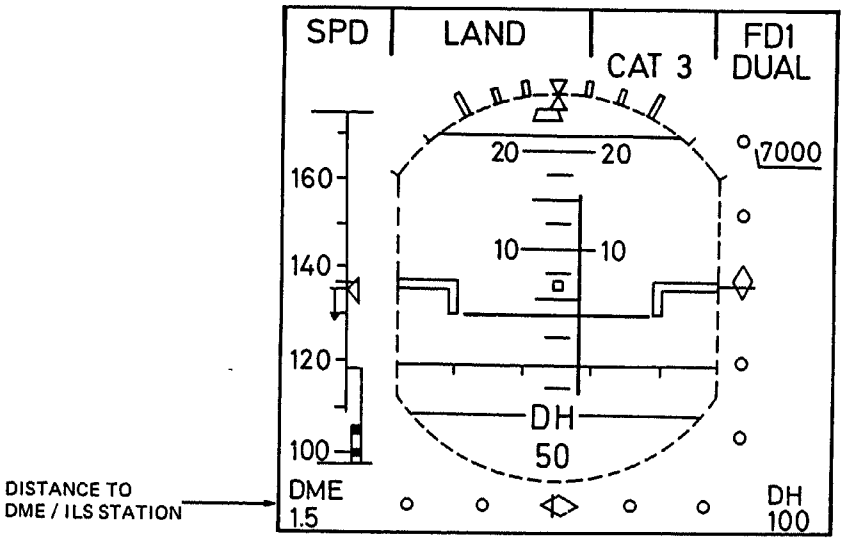
R **ON A/C 001-100,



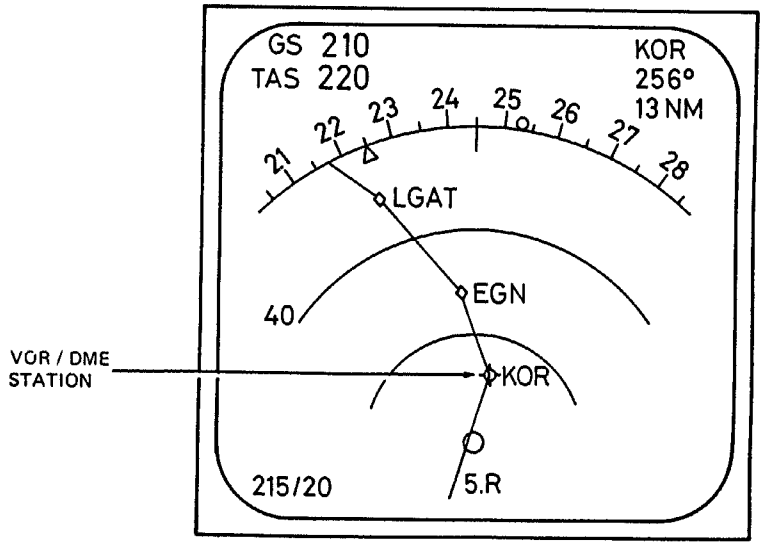


BM6 34 51 00 0 AXAO 00

DDRMI
Figure 015



PRIMARY FLIGHT DISPLAY



MAP MODE

NAVIGATION DISPLAY
(VOR. D OPTION SELECTED)

BM6 34 51 00 0 AZAO 00

DME - EFIS
Figure 016

6. Test
The selftest (BITE) is activated by pressing and holding the DME button on the AVIONICS SYS TEST panel or the TEST button on the front panel of the DME interrogator.
The following front panel indication sequence will occur:
- all LEDs come on.
- after approx. 1 sec. all LEDs go off.
- after approx. 1 sec. the 3 LEDs R/T OK, Ind. No. 1 FAIL, Ind. No. 2 FAIL come on.
- after approx. 1 sec. only the green LED R/T OK remains on until the TEST button is released.

If instead of the green R/T OK LED another LED illuminates, the following failures are indicated:

LED	Indicated Failure
red R/T FAIL	DME fail
amber BUS IN FAIL	Input not validated on the selected port (A or B)
amber ANT FAIL	Antenna disconnected
amber IND No. 1 FAIL	Indicator No. 1
amber IND No. 2 FAIL	Indicator No. 2

During the test the indicators must display the following information for correct operation:

MESSAGE	DURATION	INDICATOR DISPLAY
Failure NCD No distance	first 3 sec. second 3 sec. after the first 6 sec.	Flag Dashed lines 000.0

R **ON A/C 101-200,

6. Test
The selftest (BITE) is activated by pressing and holding the DME button on the AVIONICS SYS TEST panel or the TEST button on the front panel of the DME interrogator.
The following front panel indication sequence will occur:
- all LEDs come on.
- after approx. 3 sec. all LEDs go off.
- after approx. 3 sec. the green LED LRU STATUS PASS comes on, and goes off 1 sec. after releasing the TEST button.

If instead of the green LRU STATUS-PASS LED another LED illuminates the following failures are indicated:

LED	Indicated Failure
CONTROL INPUT FAIL	ARINC 429 input control word fail (incorrect repetition rate, sign-status matrix, parity)
LRU STATUS-FAIL	DME internal failure

During the test the indicators must display the following information for correct operation:

MESSAGE	DURATION	INDICATOR DISPLAY
Failure NCD No distance	first 3 sec. second 3 sec. after the first 6 sec.	Flag Dashed lines 000.0

R

1. Operational Test

A. Reason for the Job
(1)To ensure that the DME interrogator is operating correctly.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz

Referenced Procedures

- 24-41-00, P. Block 301	AC External Power Control

C. Procedure
(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Make certain that the following circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME 1	4SD1	C 4
21VU	RADIO NAV & COM/DME 2	4SD2	C11
21VU	RADIO NAV & COM/VOR 1	6RS1	C 2
21VU	RADIO NAV & COM/VOR 2	6RS2	C13
22VU	NAVIGATION/CAPT/RMI/VOR/DME	11FN1	F15
21VU	NAVIGATION/F/O/RMI/VOR/DME	11FN2	F10

(d)Place VOR/NAV/ILS switch on Captain's (F/O's) EFIS complementary control panel in VOR position.

NOTE : The test described below is for DME 1. The DME 2 is identical, for testing refer to information shown in brackets.

R (e)On VOR/DME control unit 3RS1 (3RS2) :
R - select a VOR frequency for which no VOR signal is received.

**ON A/C 001-100,

(2)Test

ACTION	RESULT
1. On panel 47OVU: - press and hold AVIONICS SYS TEST/DME 1 (DME 2) pushbutton.	For approx. 3 seconds a failure signal is transmitted to indicators. On both DDRMIs: - orange and white striped failure

ACTION	RESULT
	flags are displayed in DME-1 (DME-2) windows. For the next approx. 3 seconds a no computed data signal is transmitted to the indicators. On both DDRMIs: - dashed lines are displayed in DME-1 (DME-2) windows. Until the pushbutton is released, 000.0 distance data is transmitted to the indicators. On both DDRMIs: - 000.0 NM is displayed in DME-1 (DME-2) windows.
- release pushbutton.	On both DDRMIs: - dashed lines are displayed.
2. On interrogator 1 (2) front panel: - press and hold TEST pushbutton	On interrogator front panel: - all LEDs come on - after approx. 1 second all LEDs go off. - after approx. 1 second the following 3 LEDs come on: R/T OK IND No. 1 FAIL IND No. 2 FAIL - after approx. 1 second only the green LED R/T OK remains on.
- release TEST pushbutton	- the green LED R/T OK goes off.

**ON A/C 101-200,

(2)Test

ACTION	RESULT
1. On panel 47OVU: - press and hold AVIONICS SYS TEST/DME 1 (DME 2) pushbutton.	For approx. 3 seconds a failure signal is transmitted to indicators. On both DDRMIs: - DME-L (DME-R) displays are blanked. For the next approx. 3 seconds a no computed data signal is transmitted to indicators. On both DDRMIs: - dashed lines are indicated on DME-L (DME-R) displays. Until the pushbutton is released, 000.0 distance data is transmitted

ACTION	RESULT
	to the indicators. On both DDRMIs: - 000.0 NM is indicated on DME-L (DME-R) displays.
- release pushbutton.	On both DDRMIs: - dashed lines are displayed.
2. On interrogator 1 (2) front panel: - press and hold TEST pushbutton.	On interrogator front panel: - all LEDs come on. - after approx. 3 seconds all LEDs go off. - after approx. 3 seconds the green LED LRU STATUS PASS comes on.
- release TEST pushbutton.	- after approx. 1 second the green LED LRU STATUS PASS goes off.

**ON A/C ALL

(3)Close-Up
(a)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(b)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

2. Functional Test

A. Reason for the Job
(1)To ensure correct operation of DME system.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz
(2)	Headset, 600 Ohm
(3)	DME Ground Test Unit (ATC-600A, T-48D or equivalent)

Referenced Procedures

- 23-51-00, P. Block 501	Audio Integrating
- 24-41-00, P. Block 301	AC External Power Control
- 34-71-00, P. Block 501	EFIS - General
- 34-25-00, P. Block 501	Inertial Reference System (IRS)
- 34-60-00, P. Block 501	Position Computing - General

- 34-52-00, P. Block 501 ATC

C. Procedure

(1)Job Set-Up

(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(b)Make certain that electronics racks ventilation is correct.

(c)Make certain that the following circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME 1	4SD1	C 4
21VU	RADIO NAV & COM/DME 2	4SD2	C11
21VU	RADIO NAV & COM/VOR 1	6RS1	C 2
21VU	RADIO NAV & COM/VOR 2	6RS2	C13
22VU	NAVIGATION/CAPT/RMI/VOR/DME	11FN1	F15
21VU	NAVIGATION/F/O/RMI/VOR/DME	11FN2	F10

(d)Energize audio integrating system (Ref. 23-51-00, P. Block 501).

(e)Connect headset to associated connector on Captain's jack box.

(f)Select VOR 1 (VOR 2) mode on each audio selector panel and place volume controller in mid position.

(g)Energize the EFIS (Ref. 34-71-00, P. Block 501).

(h)Energize and align the IRS (Ref. 34-25-00, P. Block 501).

(j)Energize the FMS (Ref. 34-60-00, P. Block 501).

(k)Place VOR/NAV/ILS switch on Captain's and F/O's EFIS complementary control panel in VOR position.

(l)Place ground test equipment in vicinity of DME 1 (DME 2) antenna, according to the ground test equipment operating instructions.

NOTE : The test described below is for DME 1. The DME 2 is identical, for testing refer to information shown in brackets.

(2)Test

ACTION	RESULT
1. On ground test unit: - activate test unit. - select 5 NM.	
2. On VOR/DME control unit 3RS1 (3RS2): - select frequency of the ground test unit.	On both DDRMIs: - dashed lines go out of view and 5 ±0.1 NM is displayed in DME-1 (DME-2) windows. In headset: - audio tone is heard.
3. On Captain's audio selector panel: - rotate VOR 1 (VOR 2) volume controller. - place VOICE/IDENT toggle switch	In headset: - audio tone changes progressively and no crackling is heard. - audio tone is no longer heard.

ACTION	RESULT
in VOICE position. - place VOICE/IDENT toggle switch in IDENT position.	
4. Repeat test in step 3. on F/O's and third occupant station audio selector panels with headset connected successively to corresponding jack box.	
5. On ground test unit: - select 180 NM.	On both DDRMIs: - 180 ±2 NM is displayed in DME-1 (DME-2) windows.
- select 270 NM.	On both DDRMIs: - 270 ±2 NM is displayed in DME-1 (DME-2) windows.
NOTE : The remainder of the test can only be carried out if an ILS/DME beacon is within range, and this beacon with associated runway is in the data-base of the FMC.	
6. On VOR control unit 3RS1 (3RS2): - select the frequency of the local ILS/DME beacon.	On both DDRMIs: - distance between the aircraft and DME beacon is displayed in DME-1 (DME-2) windows.
7. On EFIS complimentary control panel Captain (F/O): - place VOR/NAV/ILS switch in ILS position.	On both DDRMIs: - dashed lines are indicated in DME-1 (DME-2) windows.
8. On ILS control unit 34RT: - select the frequency of the local ILS/DME beacon.	On PFD unit, LH (RH): - DME and distance between the aircraft and the DME beacon is indicated in LH lower corner. On both DDRMIs: - dashed lines remain indicated in DME-1 (DME-2) windows.
9. Energize ATC systems 1 and 2 (Ref. 34-52-00, P. Block 501).	- DME operations are not affected.

(3)Close-Up
(a)Disengage VOR 1 (VOR 2) mode on audio selector panel.
(b)Remove headset from associated jack box.
(c)De-energize the EFIS (Ref. 34-71-00, P. Block 501).
(d)De-energize the IRS (Ref. 34-25-00, P. Block 501).

(e)Remove ground test equipment
(f)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(g)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

DME ANTENNA - REMOVAL/INSTALLATION

WARNING : CLEANING AGENT (MAT. NO. 11-026) IS DANGEROUS. AVOID INHALING FUMES. USE IN WELL VENTILATED AREA ONLY. IT IS HIGHLY FLAMMABLE AND A SKIN IRRITANT. WEAR PROTECTIVE GLOVES OR USE A BARRIER CREAM. WASH IMMEDIATELY WITH CLEAN WATER, IF SKIN IS SPLASHED WITH SOLVENT.

1. Equipment and Materials

ITEM	DESIGNATION
A. Material No. 05-013	Special Materials (Ref. 20-31-00) M
B. Material No. 09-008E	Sealants (Ref. 20-31-00) M
C. Material No. 09-019	Sealants (Ref. 20-31-00) M
D. Material No. 11-026	Cleaning Agents (Ref. 20-31-00) M
E. Material No. 16-003	Structure Paints (Ref. 20-31-00) M
F.	Blanking Cap

Referenced Procedure

- 20-28-11, P. Block 1	Electrical Bonding - General D
- 34-51-00, P. Block 501	DME D

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME1	4SD1	C 4
21VU	RADIO NAV & COM/DME2	4SD2	C11

(Ref. Fig. 401)

B. Removal

NOTE : Removal procedure of DME1 and DME2 antennas is identical.

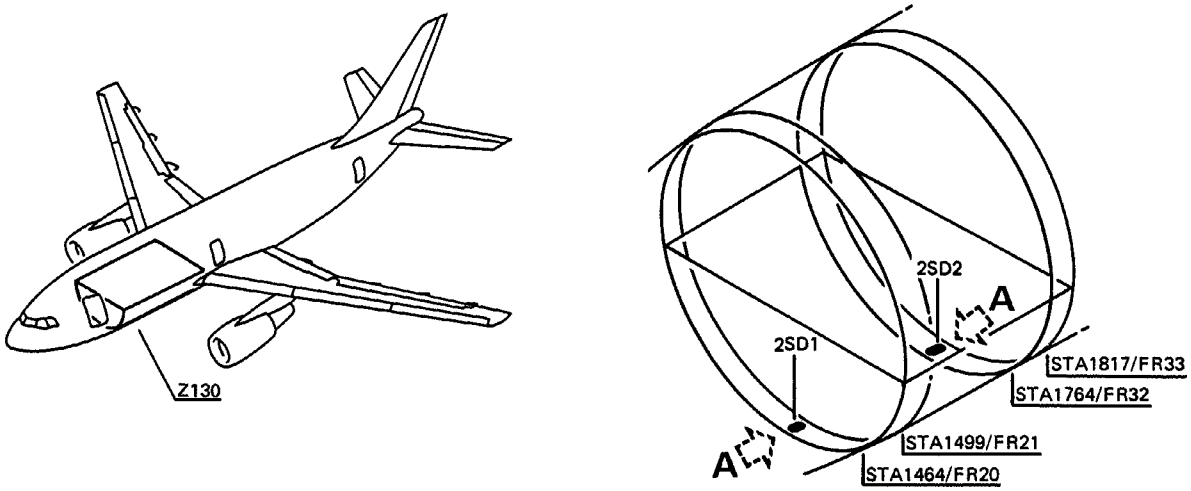
WARNING : CLEANING AGENT (MAT. NO. 11-026) IS DANGEROUS.

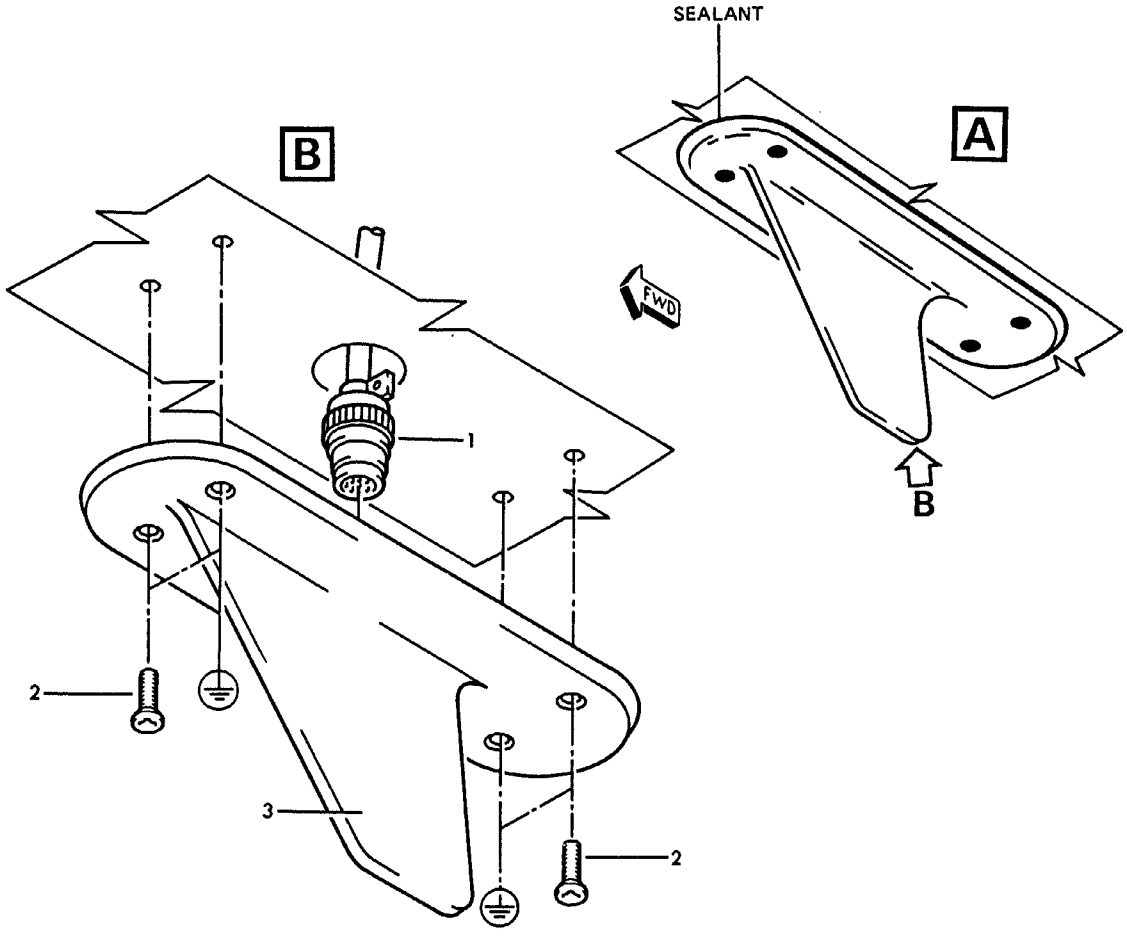
(1)Remove screws (2).
(2)Separate antenna (3) from fuselage enough to disconnect connector (1).
(3)Remove antenna (3).
(4)Fit blanking cap to connector (1).
(5)Remove old sealant from fuselage, using cleaning agent (Mat. No. 11-026).

C. Installation

NOTE : Installation procedure of DME1 and DME2 antennas is identical.

(1)Apply separating agent (Mat. No. 05-013) to mounting surfaces of antenna and fuselage.
(2)Apply sealant (Mat. No. 09-019) to mounting surfaces of antenna and fuselage.





BM6 34 51 11 4 AAAO 01

DME Antenna
Figure 401

R

NOTE : Keep ground connections clean of sealant.

(3)From connector (1) remove blanking cap and connect to antenna (3).

(4)Position antenna (3) and install on fuselage, using screws (2).

(5)Measure the bonding contact resistance between the antenna (3) and the fuselage structure (Ref. Task 20-28-11, P. Block 1).

NOTE : Make sure that the bonding contact resistance is not more than 5 milliohms.

(6)Remove excess sealant.

(7)Make a sealing bead with sealant (Mat. No. 09-008E) around the antenna.

(8)Apply sealant (Mat. No. 09-008E) on the head of the screws (2).

(9)Make the contour of the sealant on the screws (2) and around the antenna smooth.

(10)After sealant has cured, apply structure paint (Mat. No. 16-003).

NOTE : It is not mandatory to paint the sealant around the base of the antenna and on the head of the screws.

(11)Remove safety clips and tags and close circuit breakers 4SD1 and 4SD2.

D. Test

(1)Carry out DME operational test (Ref. 34-51-00, P. Block 501).

E. Close-Up

(1)Make sure that working area is clean and clear of tools and miscellaneous items of equipment.

DME INTERROGATOR 1SD1 (1SD2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-51-00, P. Block 501	DME

NOTE : The removal/installation operations for DME interrogators 1SD1 and 1SD2 are identical. Only the operations concerning interrogator 1SD1 are described.

R **ON A/C 101-200,

R (Ref. Fig. 401)

R **ON A/C 001-100,

(Ref. Fig. 402)

R **ON A/C ALL

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breaker :

(a)For DME interrogator 1SD1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM-DME1	4SD1	107/C04

(b)For DME interrogator 1SD2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM-DME2	4SD2	107/C11

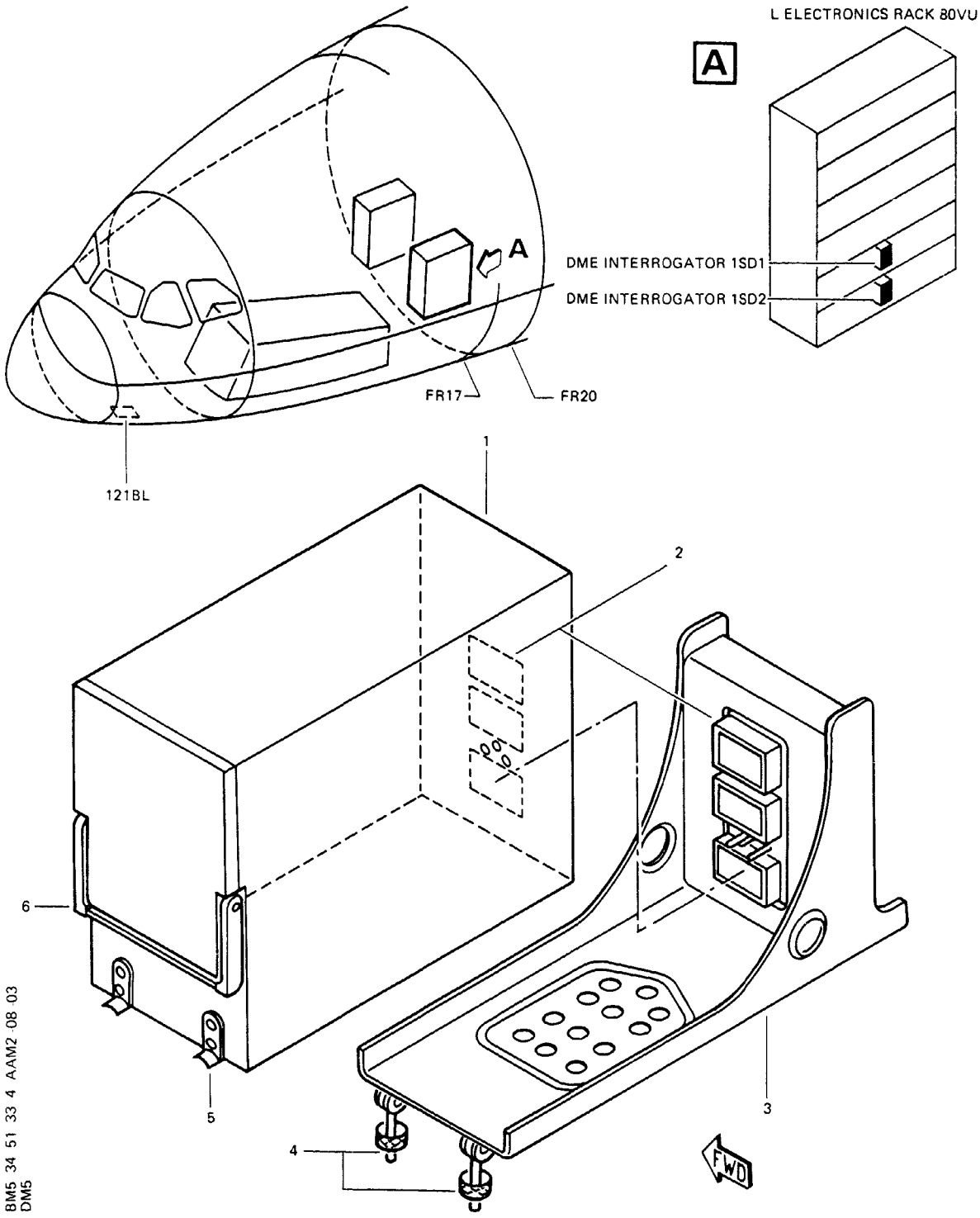
(2)Open access door 121BL to gain access to avionics compartment.

B. Removal

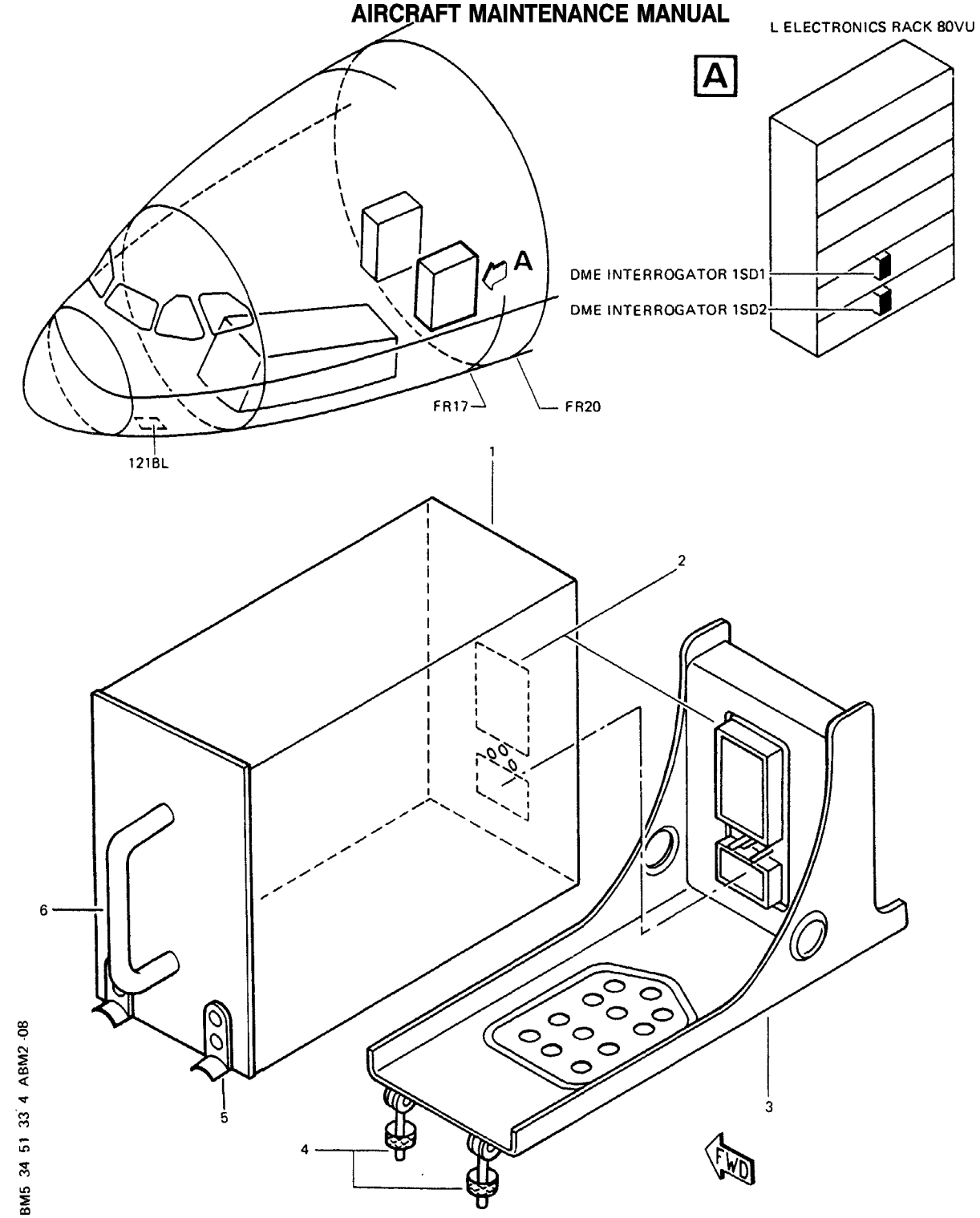
(1)Unscrew knurled nuts on tenons (4). Tilt tenons downwards to disengage them from studs (5).

R **ON A/C 101-200,

R (2)Move up handle (6) and withdraw DME interrogator (1) from rack (3),



DME Interrogator
Figure 401



DME Interrogator
Figure 402

R taking care not to damage electrical connectors (2).

R **ON A/C 001-100,

(2)Remove DME interrogator (1) from rack (3), taking care not to damage electrical connectors (2).

R **ON A/C ALL

(3)Blank electrical connectors (2).
(4)Remove DME interrogator (1).

C. Installation
(1)Clean and inspect DME interrogator interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (2).
(3)Make certain that electrical connectors (2) are clean and in correct condition.
(4)Install DME interrogator (1) in rack (3).
(5)Tilt tenons (4) upwards and lift knurled nuts into position on studs (5). Tighten.

R **ON A/C 101-200,

(6)Move down handle (6).
(7)Remove safety clip and tag and close circuit breaker :
(a)For DME interrogator 1SD1 : 4SD1
(b)For DME interrogator 2SD1 : 4SD2.

R **ON A/C 001-100,

(6)Remove safety clip and tag and close circuit breaker :
(a)For DME interrogator 1SD1 : 4SD1
(b)For DME interrogator 1SD2 : 4SD2.

R **ON A/C ALL

D. Test
Carry out operational test of DME interrogator (Ref. 34-51-00, P. Block 501).

E. Close-Up
(1)Make certain taht working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.

1. General

The ATC MODE S transponder used in the aircraft, receives interrogations from MODE S and SSR ground stations and also from TCAS equipped aircraft. Additional to earlier ATCRBS transponders the MODE S transponder is capable of sending and receiving data link messages.
Every (ATC MODE S-equipped) aircraft has its own MODE S address. This address (24-bit) is included in all MODE S transmissions, so that every interrogation can be directed to a specific aircraft and prevent multiple replies.
Also answers are unequivocal from only one specific aircraft.

MODE A Transmission of selectable code number.
MODE C Transmission of actual altidude of the aircraft.
MODE S Additional to the Mode A and Mode C transmission the 24-bit discrete address and surveillance replies.

If the discrete address is included in an interrogation, the discrete address is also a part of the reply. This is especially important for use in conjunction with TCAS.
For SSR interrogations, the transponder transmits the selectable code number (MODE A) or the actual altitude (MODE C) if required.
For SSR/MODE S all call interrogations, the transponder transmits the same information.

R

**ON A/C 001-003, 101-200,

(Ref. Fig. 001)

**ON A/C 004-100,

(Ref. Fig. 002)

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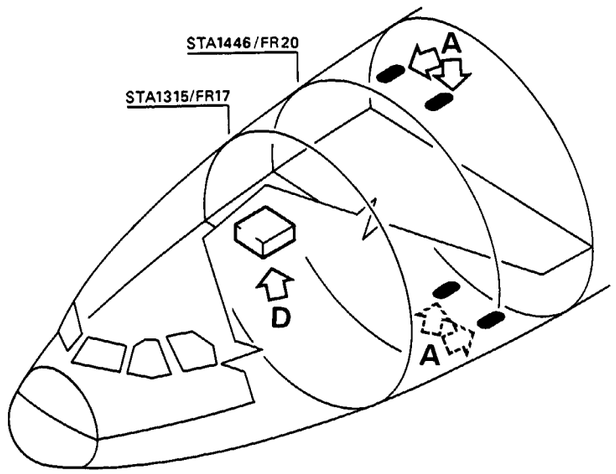
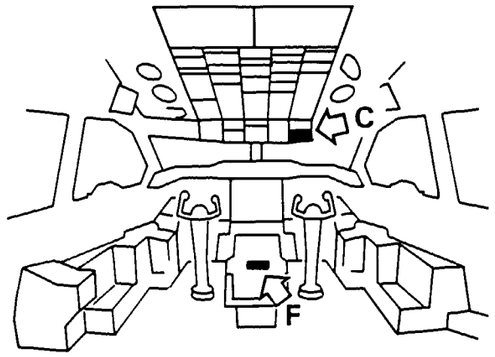
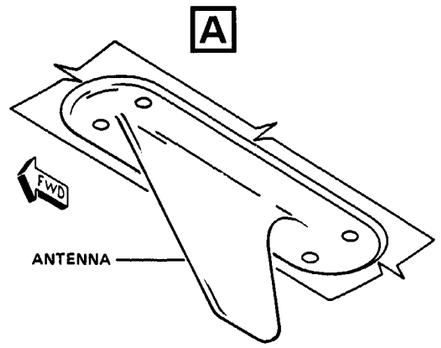
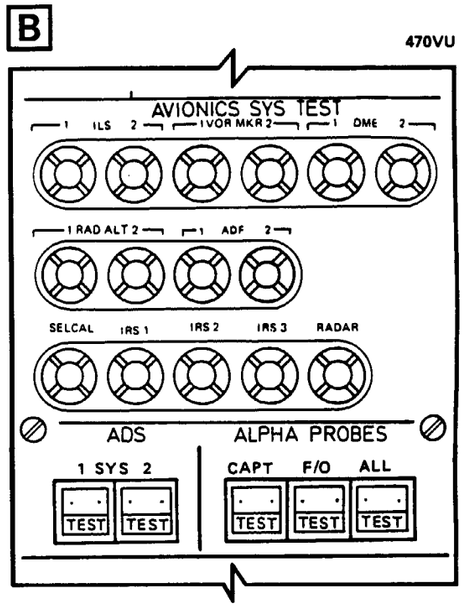
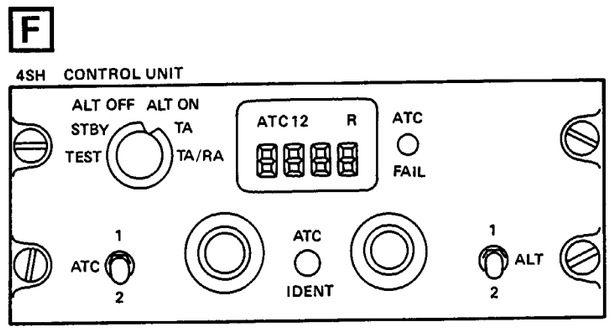
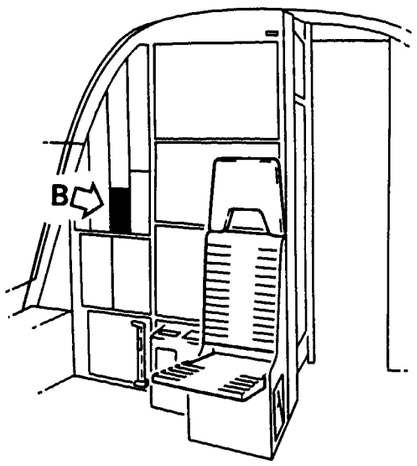


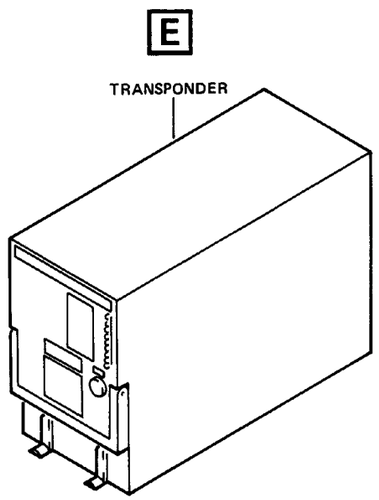


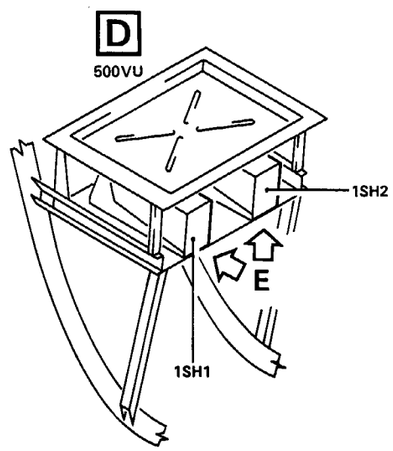


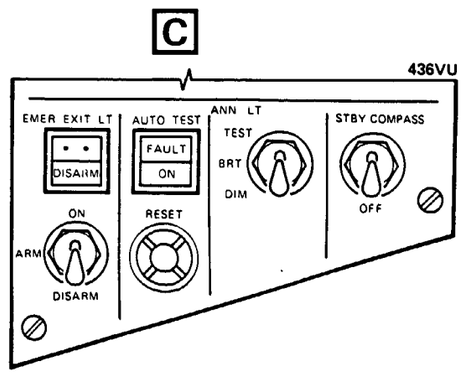












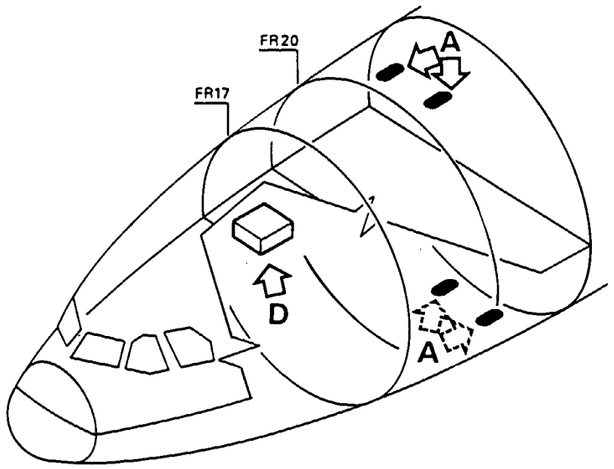
BM6 34 52 00 0 AAWO 01

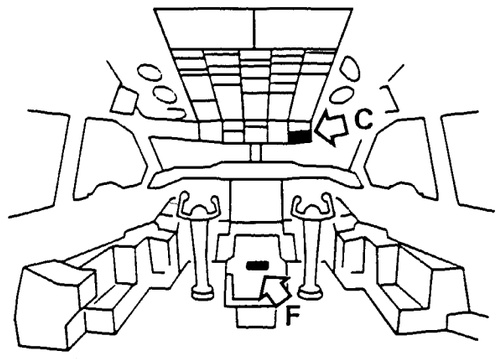
ATC - Component Location
Figure 001

R EFFECTIVITY: 001-003, 101-200,

PIA

Printed in France





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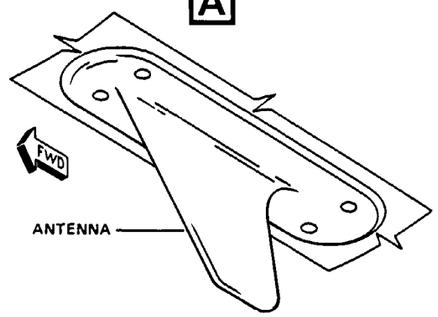

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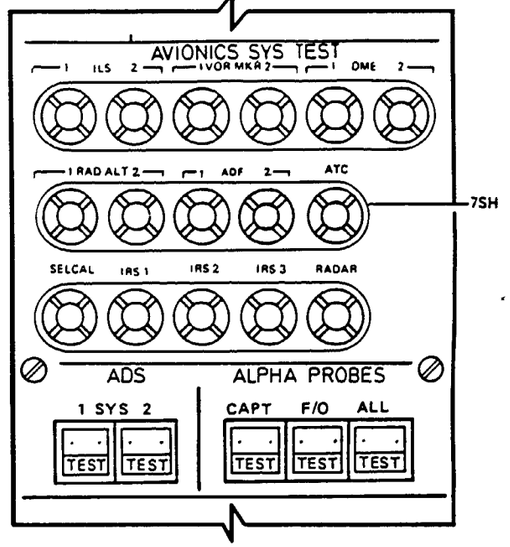

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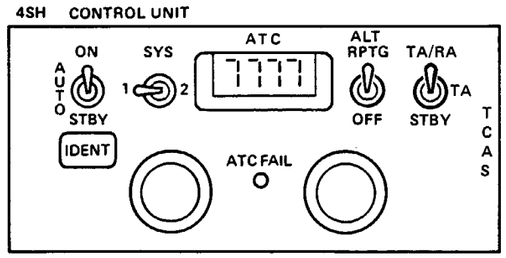

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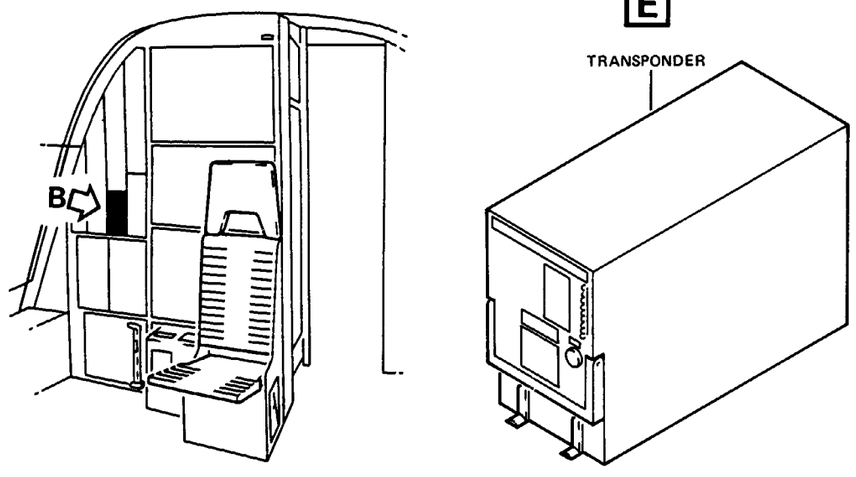

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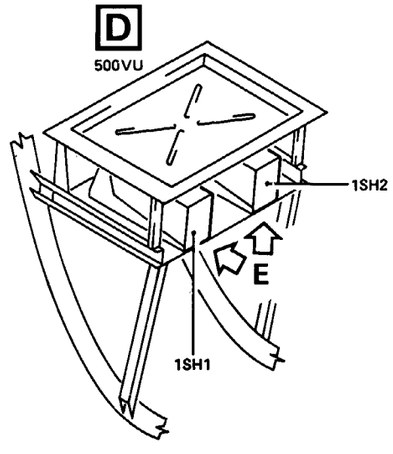
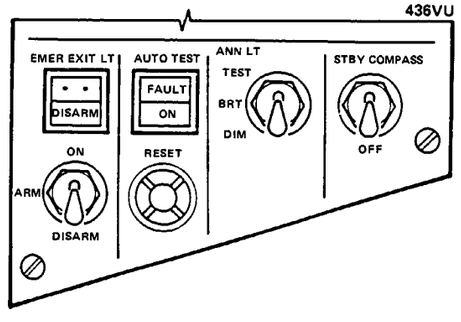


C



BM6 34 52 00 0 AAZO 00

ATC - Component Location
Figure 002

R

R EFFECTIVITY: 004-100,

PIA

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**ON A/C ALL

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
	ATC SYSTEM:				
1SH1	TRANSPONDER ATC1	500VU	122		34-52-33
1SH2	TRANSPONDER ATC2	500VU	122		34-52-33
4SH	CONTROL UNIT-ATC 1/2	11VU	211		34-52-13
6SH1	ANTENNA-ATC1		133		34-52-11
6SH2	ANTENNA-ATC2		134		34-52-11
6SH3	ANTENNA-ATC1		234		34-52-11
6SH4	ANTENNA-ATC2		233		34-52-11
7SH	ATC TEST BUTTON (if fitted)	470VU	211		
	ASSOCIATED SYSTEMS:				
1CK1	FLIGHT MANAGEMENT COMPUTER 1	83VU	121		
1FL1	AIR DATA COMPUTER 1	96VU	121		
1FL2	AIR DATA COMPUTER 2	86VU	121		
19FL1	ADC INST. SEL. SWITCH	402VU	211		
19FL2	ADC INST. SEL. SWITCH	406VU	212		
143GB	AIR-GROUND RELAY	83VU	121		

NOTE : For system components which are mentioned but not described in detail please refer to: *

FMC	(Ref. 34-60-00)
ADS	(Ref. 34-11-00)
Instr. & PNL. Int. Light	(Ref. 33-13-00)
Annunciator Light Dimm.	(Ref. 33-16-00)

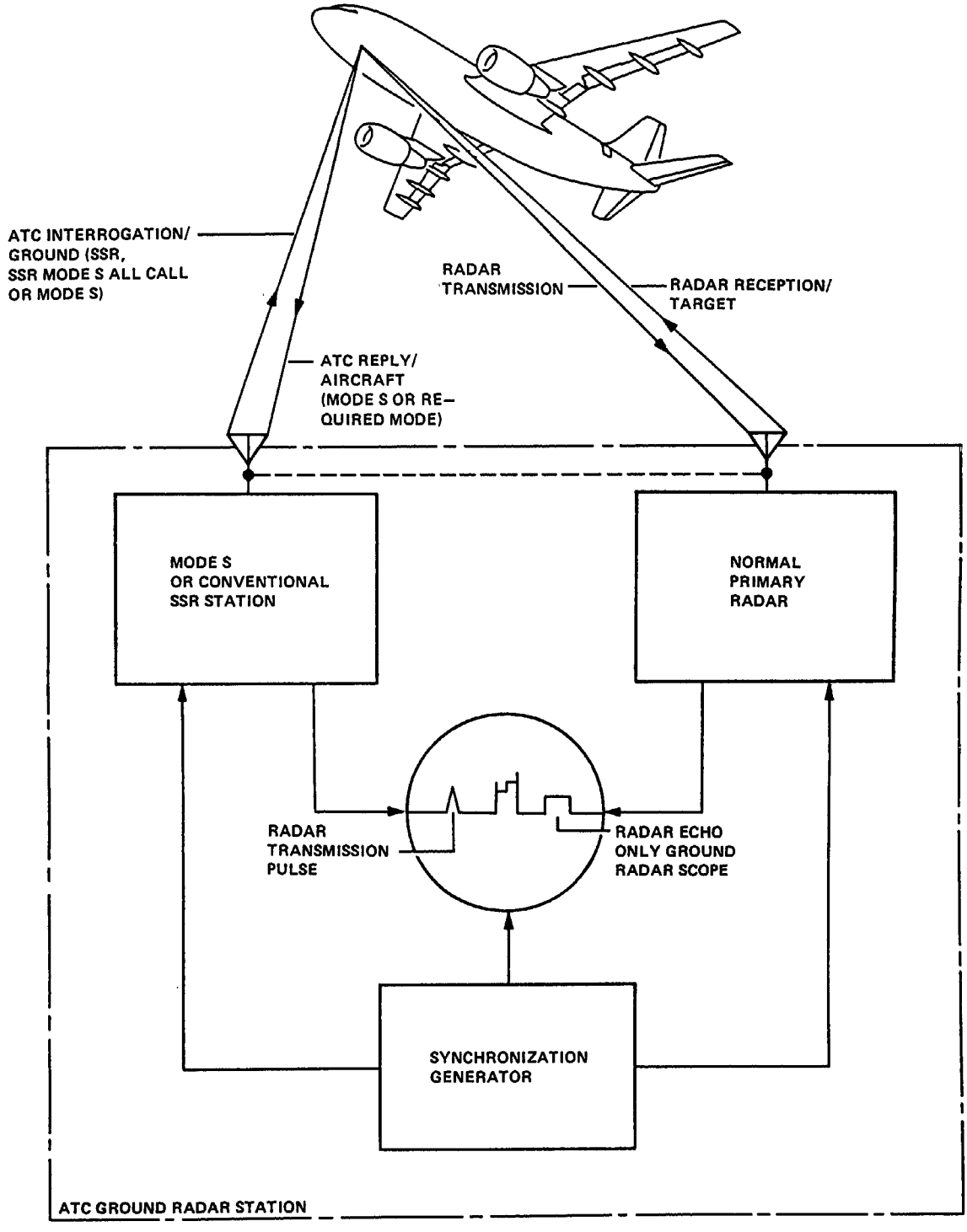
3. System Description

A. Principle (Ref. Fig. 003, 004, 005)
The ATCRBS is a radio navigation aid which enables the ATC operators to be informed about identification and/or flight altitude of an A/C which is visible on the radar screen as a passive radar echo.
The ground part of the so called secondary radar system is an interrogator which operates via a rotating antenna. The antenna pattern is a narrow beam. Whenever the beam hits the A/C the onboard ATC Transponder is initiated to transmit a reply.
If the interrogations are MODE S interrogations, (interrogations are including the specific A/C address) only the so addressed A/C gives a reply, respectively a communication between the ground station and the A/C is practicable.
The interrogation modes used are:
- A, for common civil and military ATC.
  It requires: transmission of a selectable code number.
- C, for altitude reporting.
  It requires: transmission of a selectable code number and the actual flight altitude of the A/C.
- S, select and all call surveillance replies.

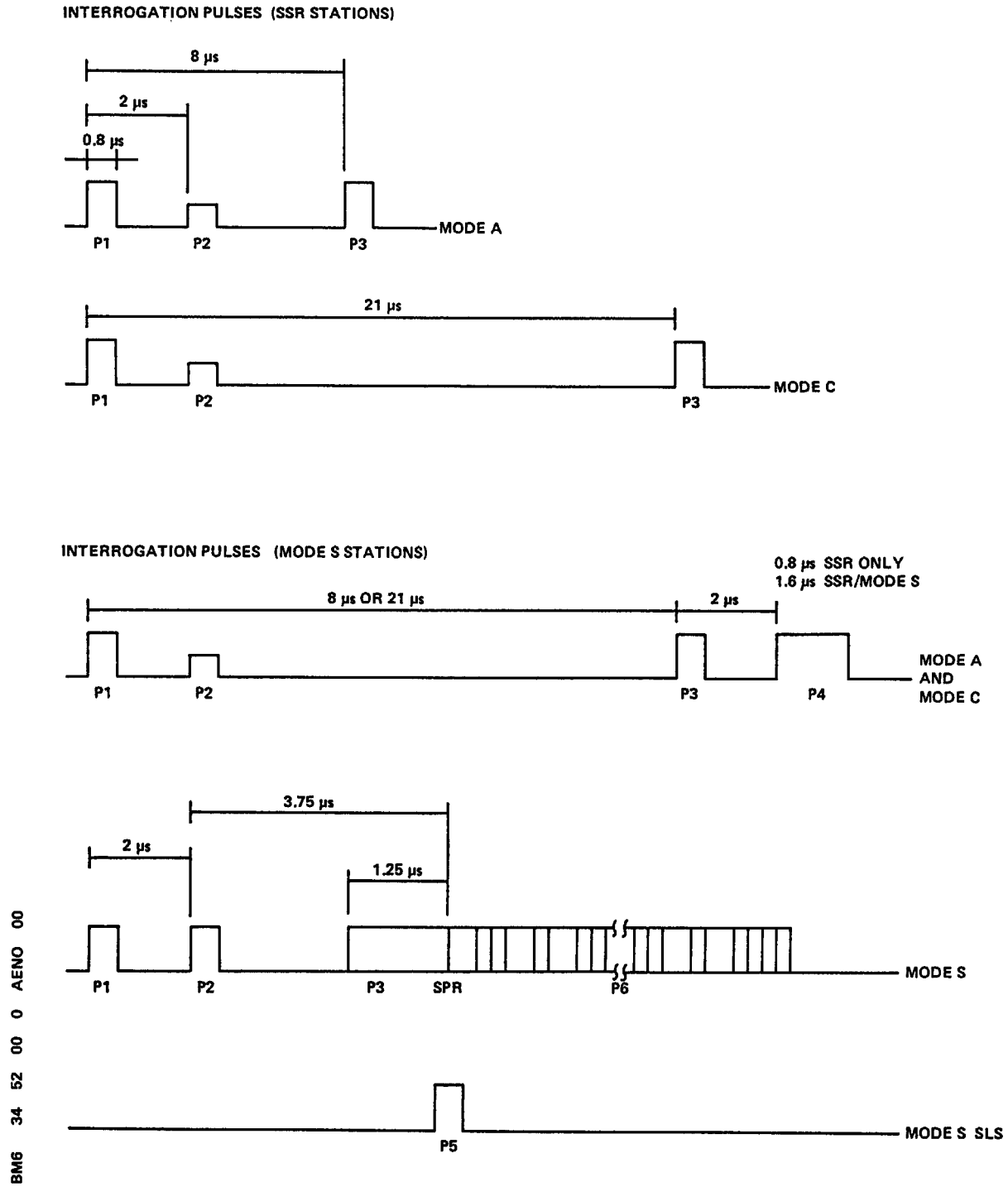
Interrogation and replies are coded in pulse groups.
The interrogation frequency is 1030 MHz.
The reply frequency is 1090 MHz.

B. System Architecture (Ref. Fig. 006)
The A/C is equipped with two ATC Mode S systems. In each system the ATC transponder is connected to:
- the common Control Unit installed on the pedestal
- the flight management system
- the air data systems
- the two DME systems
- (the TCAS, if available)
- the AIR/GROUND (Relay) switch
- the ATC antenna installed on the lower fuselage
- the ATC antenna installed on the upper fuselage

The Control Unit provides digital code and function data to the transponder and receives status data from the transponder.
The ADSs provide altitude data to the transponder for transmission.
The FMCs provide the flight identification to the transponder (four ARINC 429 datawords, LABEL 233...236)
The test circuit activates the ATC BITE which is realized by a reply procedure.
The connection to the suppression line between all ATC and DME systems (and TCAS if available) makes sure that all other systems are suppressed when one system is transmitting. The Air/Ground (Relay) switch informs the transponder if the A/C is airborne. It inhibits replies as long as the A/C is on the ground.
(Ref. Fig. 006)


ATC INTERROGATION/ GROUND (SSR, SSR MODE S ALL CALL OR MODE S)
RADAR TRANSMISSION
RADAR RECEPTION/ TARGET
ATC REPLY/ AIRCRAFT (MODE S OR RE-QUIRED MODE)
MODE S OR CONVENTIONAL SSR STATION
NORMAL PRIMARY RADAR
RADAR TRANSMISSION PULSE
RADAR ECHO ONLY GROUND RADAR SCOPE
SYNCHRONIZATION GENERATOR
ATC GROUND RADAR STATION
BM6 34 52 00 0 ACNO 00

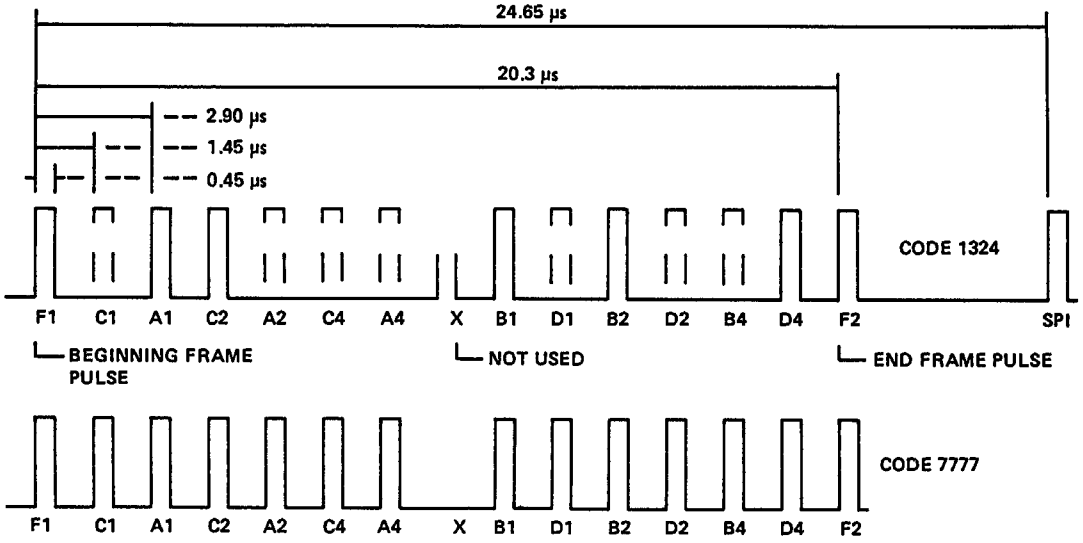
ATC - System Principle
Figure 003



BM6 34 52 00 0 AENO 00

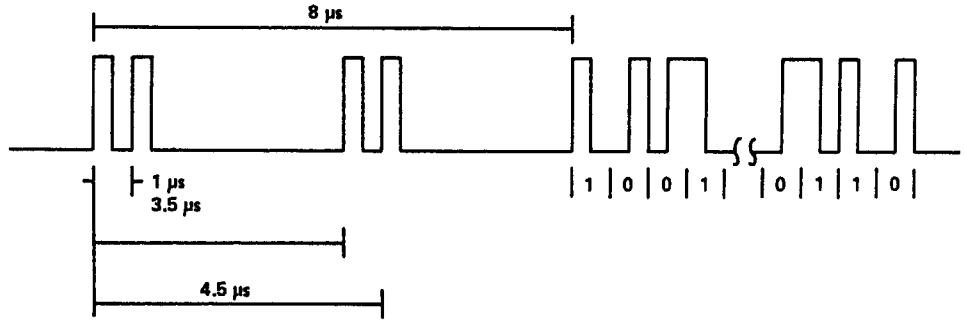
ATC - Interrogation Pulses
Figure 004

REPLY PULSES (MODE A) EXAMPLE


24.65 µs
20.3 µs
2.90 µs
1.45 µs
0.45 µs
CODE 1324
F1 C1 A1 C2 A2 C4 A4 X B1 D1 B2 D2 B4 D4 F2 SPI
BEGINNING FRAME PULSE
NOT USED
END FRAME PULSE
CODE 7777
F1 C1 A1 C2 A2 C4 A4 X B1 D1 B2 D2 B4 D4 F2

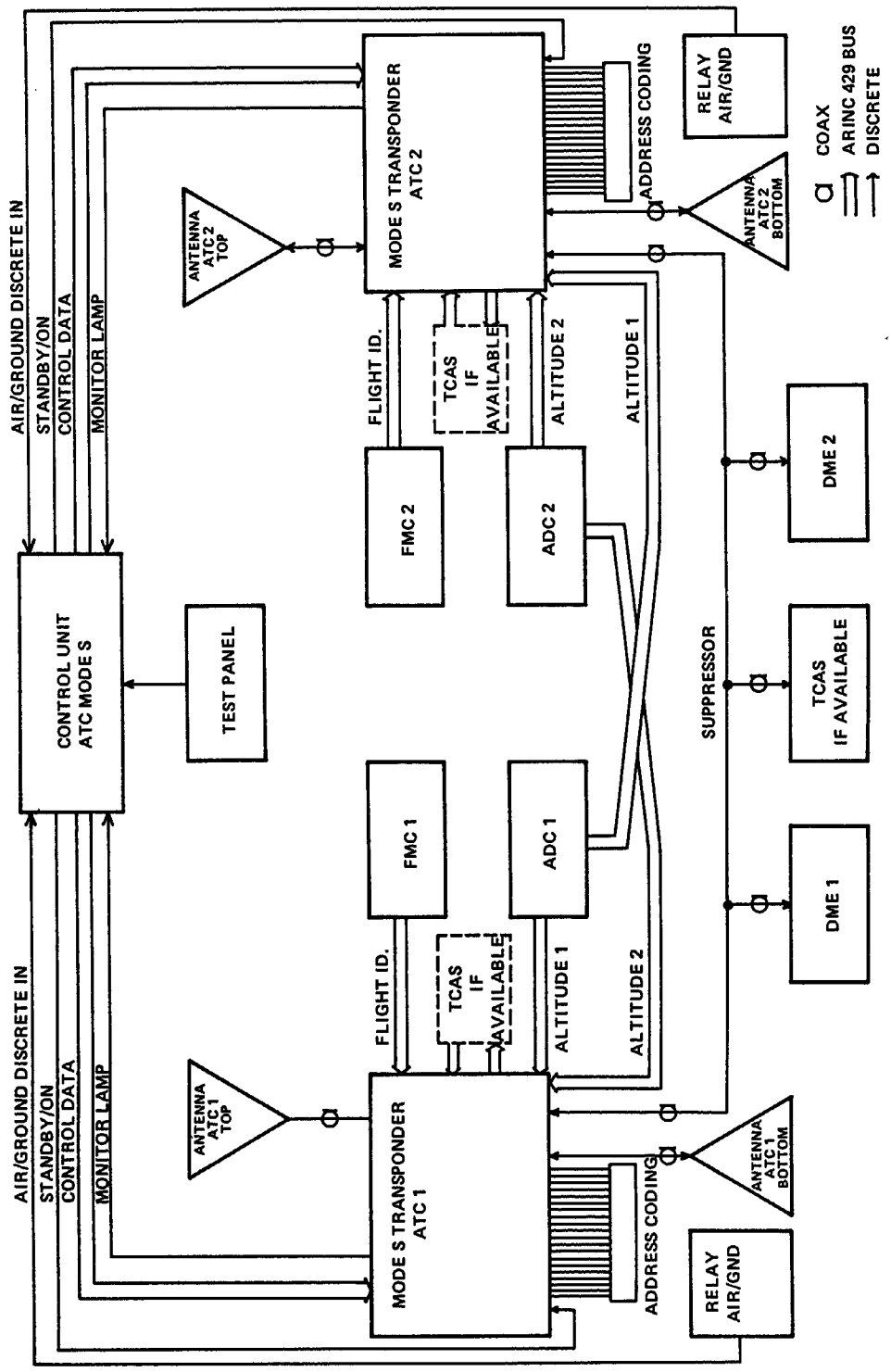
MODE C REPLY PULSES ARE SIMILAR. ONLY THE MEANING OF BIT A1 THRU D4 IS THE CODED ALTITUDE INFORMATION.

REPLY PULSES MODE S



BM6 34 52 00 0 AEPO 00

ATC - Reply Pulses
Figure 005



BM6 34 52 00 0 AFA0 00

ATC - System Architecture
Figure 006

**ON A/C ALL

R

C. Power Supply (Ref. Fig. 007)
The ATC systems are supplied with 115 V AC, 400 Hz.
- the ATC transponder 1 and the control unit 4SH are supplied by the emergency busbar 401XP via circuit breaker 3SH1.
- the ATC transponder 2 and the control unit 4SH are supplied by the normal busbar 205XP via circuit breaker 3SH2.

The instrument and panel lighting system provides 5 V AC for the display and panel lights in the control unit 4SH (Ref. 33-13-00).
The annunciator light dimming system provides a voltage of up to 28 V DC for the monitor lights (Ref. 33-16-00).
The power consumption of each system is 75 VA.

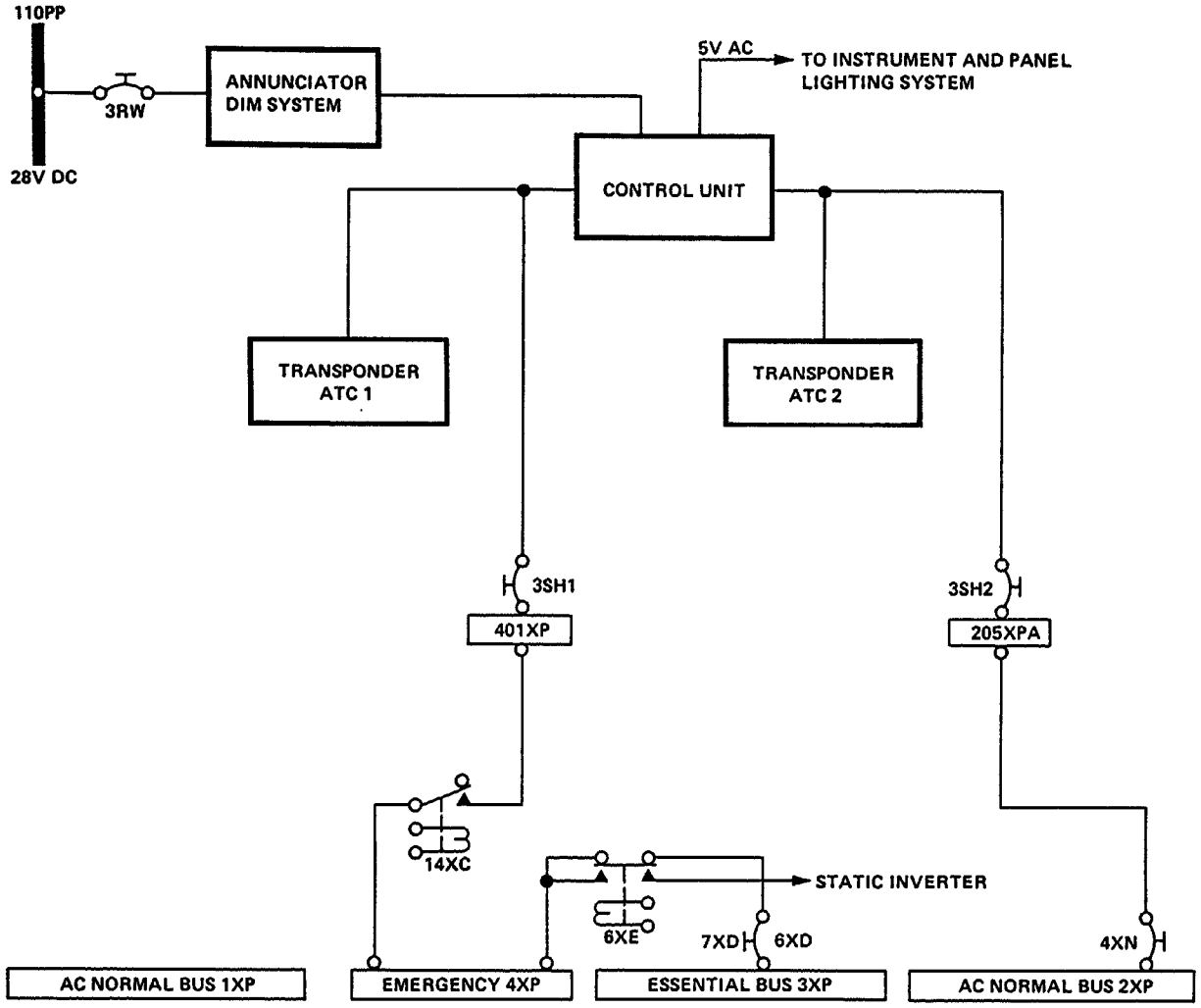
**ON A/C ALL

(Ref. Fig. 007)

4. Component Description

A. ATC Transponder
(1)Description
The transponder provides the ground based ATC center with coded reply signals, to interrogation modes A and C and special identification, containing the aircraft's identification and altitude data.
Also the transponder transmits MODE S reply messages, when it receives MODE S interrogations from other, TCAS-equipped A/C or MODE S-ground stations.
That means AIR-to-AIR transmission to other A/C and AIR-to-GROUND and Ground-to-Air transmissions.
The unit is housed in an ARINC 600 4MCU case. It contains a micro-processor based control and processing unit for MODE S and ATCRBS.
The major assemblies are the power supply, RF transmitter, RF receiver, RF interface circuit card and the CPU I/O circuit card.
The front panel features:
- self test indicators
- a pushbutton test switch
- a handle

Interface connectors (ARINC 600) are fitted on the rear panel.
(2)Operation
A microprocessor controls all operations and data processing in the transponder.
Reception
- All interrogations received at antenna level are directed to the receiver.
- Pulses are detected, the system discriminates between SSR, SSR/MODE S



BM6 34 52 00 0 AJC0 00

ATC - Power Supply
Figure 007

All call and MODE S interrogations.
- The system decodes pulse P2 in modes A or C and pulse P5 in SSR/MODE S All call for validation.
- Dependent on validity and interrogation mode a respective reply code will be generated.

Transmission
Reply pulses generated by the register control all the transmission amplifiers.
Suppression control
While the reply signal is being transmitted, the transponder generates a suppression pulse to the other airborne units equipments (DME, TCAS), which operate on a frequency close to the transponder frequency.
The transponder is capable of receiving external suppression pulses in order to suppress its transmission (when DME or TCAS transmission occurs).

(3)Frequency
The interrogation signal received by the equipment is at a frequency of 1030 MHz.
SSR MODE A and MODE C interrogation.
- When the interrogation signal is located in the main beam of the interrogating radar, it consists of two identical pulses P1 and P3, separated according to the selected mode.
- When the interrogation signal is located in a side lobe of the interrogating radar, it consists of the two identical pulses P1 and P3 and another pulse P2 which has similar characteristics but greater amplitude height than P1 and appears 2 μ s after P1. In this case, the equipment transmits no reply.
- SLS for MODE S formats characterized by the reception of a pulse P5 coincident with the SPR in P6. The decoder cannot see the SPR and therefore it will not process the interrogation.
- If the received interrogation contains a 1.6 μs pulse (P4), the transponder will detect the interrogation as an SSR/MODE S interrogation on condition that the amplitude height is the same like P3. Otherwise it detects the interrogation as an ATCRBS interrogation.
- If the interrogation is a valid interrogation and the pulse P4 is 0.8 μs, the interrogation is an ATCRBS only All call. The transponder does not reply.

(4)Encoding
- In the interrogation signal, the interrogation mode is only identified by the separation between the P1 and P3 pulses.

This separation is 8 μs in mode A and 21 μs in mode C measured from the leading edge of the pulse P1.
The reply signal consists of:
- Two F1 and F2 framing pulses, separated by a 20.3 μs time interval. Encoding (to Gray code) is done by means of the presence (1) or absence (0) of 13 pulses (12 pulses plus an X pulse).
  These pulses are identified by the letter of their group, followed by the digit they represent within that group.
- Beside this information, the reply information can contain (at t = 24.65 μs with respect to F1) the SPI pulse (Special Pulse

Identification). After the request is reset, this pulse must remain for at least 20 ± 5 μ seconds.
The MODE S reply consists of:
- A four pulse preamble (duration 8 μs) followed by the reply data pulses (56 or 112 bit). The replies are PPM coded.
  The formates are described in ARINC 718 and RTCA/DO-181).

**ON A/C 105-200,

(5)Elementary and Enhanced Surveillance Operation

Elementary Surveillance is the transmission of the following 4 parameters from the selected Mode-S transponder:

	Parameter	Source
1.	Flight ID	FMS
2.	Pressure Altitude	ADC
3.	Flight Status	Air Ground Relay
4.	Capabilities Report	Transponder internally generated

The Flight ID and Pressure Altitude parameters are provided to each transponder via ARINC 429 busses. Elementary Surveillance parameters are tested during a transponder functional check.
Elementary Surveillance will be required for aircraft that operate in European airspace.

Enhanced Surveillance is the transmission of the following 9 parameters from the selected Mode-S transponder:

BDS Number	Description	Datasource	ARINC 429 Label
6,0	Magnetic Heading	IRU	320
	Indicated Airspeed	ADC	206
	Mach No.	ADC	205
	Altitude Rate (baro rate of climb/ descend)	ADC	212
5,0	Roll Angle	IRU	325
	Track Angle Rate	IRU	335
	True Track Angle	IRU	313
	Ground Speed	IRU	312
4,0	Selected Altitude	FCU	102

These parameters are provided to each transponder via ARINC 429 busses from the above listed sources. These parameters will only be transmitted by the transponder when requested from ATC. Enhanced parameters are not

tested in a transponder functional check, separate test procedures are required for testing of Enhanced Parameters. Enhanced Parameters will be required for aircraft operation in European airspace.

**ON A/C 001-003, 101-200,

B. Control Unit (Ref. Fig. 008)
The processor based unit conforms to the ARINC 718 specification. The front panel is integrally lit by clear 5 V lamps and features:
- a liquid crystal display window, in which the identification code and the selected transponder are displayed.
- one indicator light, for ATC FAIL indication.
- an IDENT pushbutton which is used to generate additional identification pulses in the reply signal.
- two double knobs to select the four-digit transmit code. The code range is 0000 to 7777.
- an ALT toggle switch which selects altitude information from ADS 1 or 2.
- a SYS toggle switch which enables the selection of the ATC 1 or ATC 2 system.
- a rotary selector which controls the power supply for the transponder, the ALT ON/OFF switching, and in TEST position it permits the transponder to be tested from cockpit.

The processor controls the function of the unit and:
- converts the identification code selected into ARINC 429 format transmission to the transponder.
- provides selected code data to drive the liquid crystal display.
- activates the appropriate control lights when a fault or reply signal is received.

NOTE : Emergency codes are 7500, 7600, 7700 on MODE A and their complements 0277, 0177 and 0077.

**ON A/C 004-100,

B. Control Unit (Ref. Fig. 009)
The processor based unit conforms to the ARINC 718 specification. The front panel is integrally lit by clear 5 V lamps and features:
- a liquid crystal display window, in which the identification code is displayed.
- one indicator light, for ATC FAIL indication.
- an IDENT pushbutton which is used to generate additional identification pulses in the reply signal.
- two double knobs to select the four-digit transmit code. The code range is 0000 to 7777.
- an ALT RPTG toggle switch which inhibits altitude information when in the OFF position.
- an SYS toggle switch which enables the selection of the ATC 1 or ATC 2 system.
- an STBY/AUTO/ON toggle switch which switches off the power supply to

the transponders in STBY position.
- In AUTO position responses of ATC transponder will be controlled by the AIR/GND relay.
- a TCAS control switch (Ref. 34-44-00).

The processor controls the function of the unit and:
- converts the identification code selected into ARINC 429 format transmission to the transponder.
- provides selected code data to drive the liquid crystal display.
- activates the appropriate control lights when a fault signal is received.

NOTE : Emergency codes are 7500, 7600, 7700 on MODE A and their complements 0277, 0177 and 0077.

**ON A/C 001-003, 101-200,

(Ref. Fig. 008)

**ON A/C 004-100,

(Ref. Fig. 009)

**ON A/C ALL

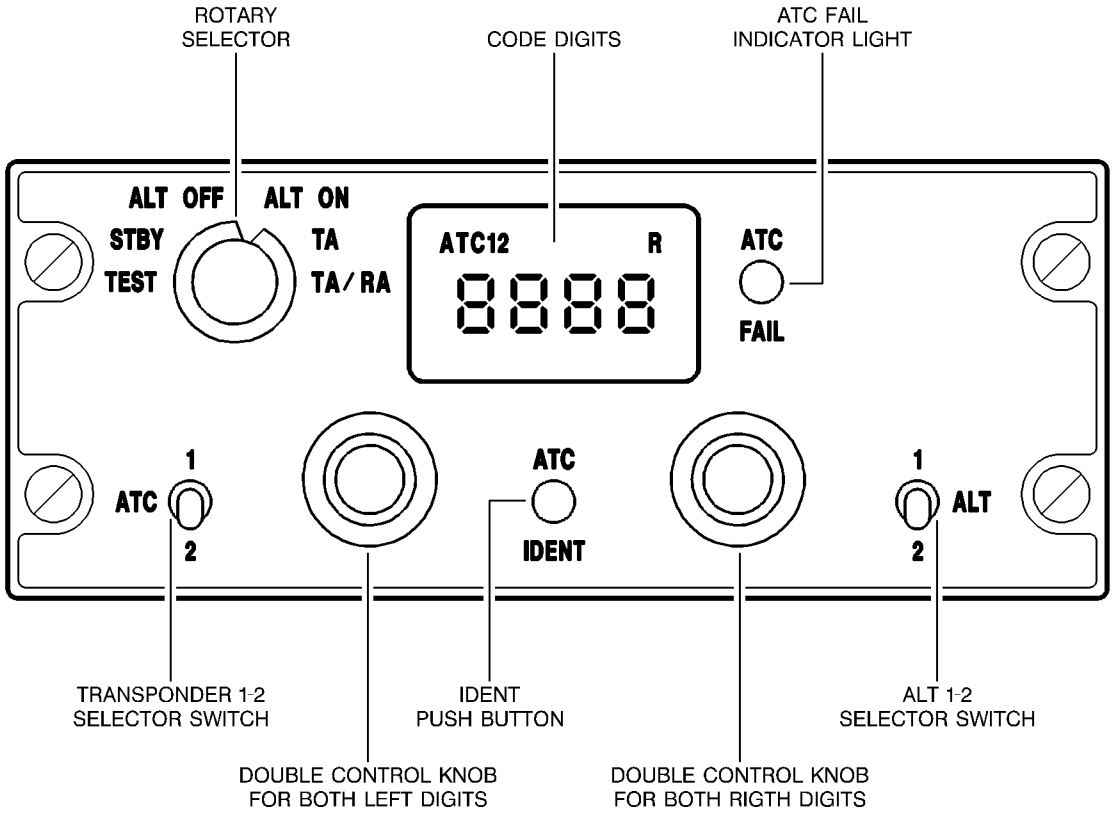
C. Antenna (Ref. Fig. 010)
The L-band antenna is a short stub all aluminum blade type which is completely sealed to prevent failure from moisture incursion.
It is vertically polarized, has an impedance of 50 ohms, a VSWR of 1.5:1 and operates in the 960 MHz to 1220 MHz frequency band.
Lightning protection is provided to prevent damage to the antenna and the transponder.

**ON A/C 001-003, 101-200,

5. System Operation

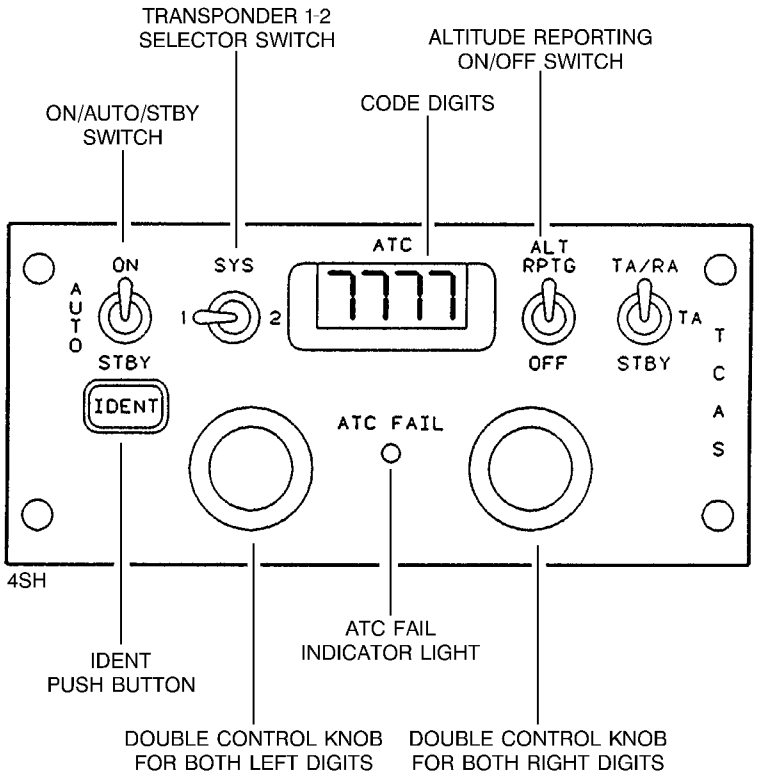
A. Energization (Ref. Fig. 011)
The control unit and the transponders are energized when busbars 401XP and 205XPA are supplied and the corresponding circuit breakers closed.
The air data system (Ref. 34-11-00), the instrument and panel lighting (Ref. 33-13-00), and the annunciator light dimm. (Ref. 33-16-00) must also be energized.

B. Control
(1)System selection
An ATC system is selected by placing the ATC switch on the control unit in either position 1 or 2. The transponder, however, is not energized until the mode selector switch is in ALT ON or ALT OFF position.
(2)Code selection
At power up, the last code entered will be displayed on the liquid crys-



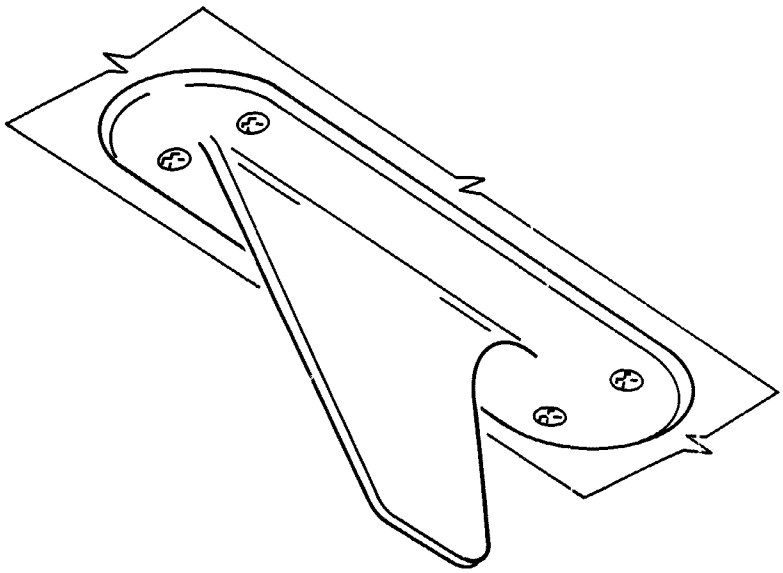
BM5 34 52 00 0 ALJ0 01

ATC - Control Unit
Figure 008



BM5 34 52 00 0 ALL0 01

ATC - Control Unit
Figure 009



BM6 34 52 00 0 AR M O

ATC - Antenna
Figure 010

tal display in the control unit window.
The ATC (octal numbers) can be selected by two double turn knobs on the control unit (one for each digit).
Push ident button, and momentary the additional identification bit will be generated within the reply pulse groups.

(3)Altitude Reporting
Altitude information from the ADC is transmitted by the transponder when the ALT RPTG switch is in either positon 1 or 2 and the rotary selector is in ALT ON.

C. Lighting Control
The integral lighting of the ATC control unit is controlled by the PED OVHD PANEL LT brightness control knob on panel 414VU on the pedestal.
The brightness of the indicator light 'ATC FAIL' is controlled by the annunciator TEST/BRT/DIM switch on panel 436VU.

**ON A/C 004-100,

5. System Operation

A. Energization (Ref. Fig. 012)
The control unit and the transponders are energized when busbars 401XP and 205XPA are supplied and the corresponding circuit breakers closed.
The air data system (Ref. 34-11-00), the instrument and panel lighting (Ref. 33-13-00), and the annunciator light dimm. (Ref. 33-16-00) must also be energized.

B. Control
(1)System selection
An ATC system is selected by placing the SYS switch on the control unit in either position 1 or 2. The transponder, however, is not energized until the ON/AUTO/STBY switch is in the ON or AUTO position.

(2)Code selection
At power up, the last code entered will be displayed on the liquid crystal display in the control unit window.
The ATC (octal numbers) can be selected by two double turn knobs on the control unit (one for each digit).
Push ident button, and momentary the additional identification bit will be generated within the reply pulse groups.

(3)Altitude Reporting
Altitude information from the ADC is transmitted by the transponder when the ALT RPTG switch is in the ALT RPTG position.

(4)TCAS control switching (Ref. 34-44-00).

C. Lighting Control
The integral lighting of the ATC control unit is controlled by the PED OVHD PANEL LT brightness control knob on panel 414VU on the pedestal.
The brightness of the indicator light 'FAIL' is controlled by the annunciator TEST/BRT/DIM switch on panel 436VU.

**ON A/C 001-003, 101-200,

(Ref. Fig. 011)

**ON A/C 004-100,

(Ref. Fig. 012)

R **ON A/C 101-200,

6. Test
NOTE : A special test code is not necessary.

A. The Built-In Test Equipment (BITE) is activated by using the ATC push-button 7SH on panel AVIONICS SYS TEST 47OVU or the TEST pushbutton on the respective transponder front panel 1SH1 or 1SH2 (Ref. Fig. 013).
(1)If the TEST pushbutton on the front panel of the respective transponder is pressed and held, a lamp test will be initiated. All LEDs come on for three seconds and after these three seconds the LEDs go off for three seconds.
After lamp test the respective LEDs come on only if there is any malfunction to display respectively normal operation for the green LED.
(2)Using the pushbutton 7SH the FAIL lamp comes on, goes off and after the test, the FAIL lamp at the control panel will lit, if there is any fault to display.
(3)Indicator List:

INDICATOR/ CONTROL	FUNCTION
-	Green LED will light after lamp test indicates normal operation.
TPR -	Red LED will light after lamp test indicates malfunction.
ALT	Red LED will light after lamp test indicates abnormal input from ALT data system bus, or associated circuitry.
DATA IN	Red LED will light after lamp test indicates abnormal input of ARINC 429 word data from control panel, or associated circuitry.
TOP ANT	Red LED will light after lamp test indicates malfunctioning top antenna, or associated circuitry.
BOT	Red LED will light after lamp test indicates malfunctioning bottom antenna, or associated circuitry.
TCAS	Red LED will light after lamp test indicates abnormal input of ARINC 429 word data from the TCAS unit, or associated

INDICATOR/ CONTROL	FUNCTION
	circuitry (if TCAS is installed).
MAINTENANCE	Red LED will light after lamp test indicates abnormal input from Maintenance data system bus, or associated circuitry.
TEST	The TEST pushbutton initiates lamp test and self-test.

**ON A/C 001-100,

R

6. Test
NOTE : A special test code is not necessary.

A. The Built-In Test Equipment (BITE) is activated by using the TEST position at the control panel 4SH, or the TEST pushbutton on the respective transponder front panel 1SH1 or 1SH2 (Ref. Fig. 013).
(1)If the TEST pushbutton on the front panel of the respective transponder is pressed and held, a lamp test will be initiated. All LEDs come on for three seconds and after these three seconds the LEDs go off for three seconds. After lamp test the respective LEDs come on only if there is any malfunction to display respectively normal operation for the green LED.
(2)Using the TEST position at the control panel 4SH, the FAIL lamp comes on, goes off and after the test, the FAIL lamp will lit, if there is any fault to display.
(3)Indicator List:

INDICATOR/ CONTROL	FUNCTION
-	Green LED will light after lamp test indicates normal operation.
TPR -	Red LED will light after lamp test indicates malfunction.
ALT	Red LED will light after lamp test indicates abnormal input from ALT data system bus, or associated circuitry.
DATA IN	Red LED will light after lamp test indicates abnormal input of ARINC 429 word data from control panel, or associated circuitry.
TOP ANT	Red LED will light after lamp test indicates malfunctioning top antenna, or associated circuitry.
BOT	Red LED will light after lamp test indicates malfunctioning

INDICATOR/ CONTROL	FUNCTION
	bottom antenna, or associated circuitry.
TCAS	Red LED will light after lamp test indicates abnormal input of ARINC 429 word data from the TCAS unit, or associated circuitry (if TCAS is installed).
MAINTENANCE	Red LED will light after lamp test indicates abnormal input from Maintenance data system bus, or associated circuitry.
TEST	The TEST pushbutton initiates lamp test and self-test.

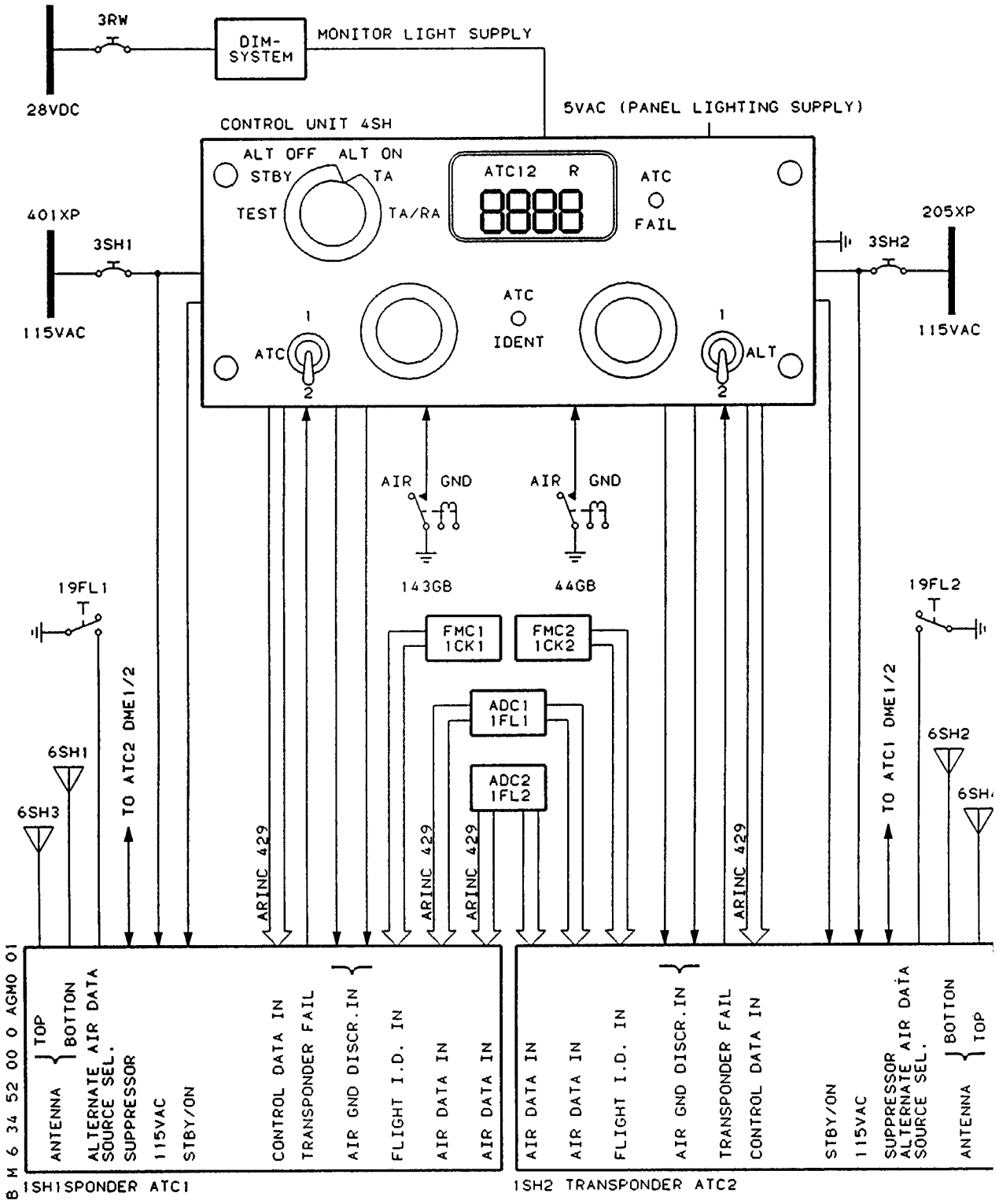
**ON A/C ALL

(Ref. Fig. 013)

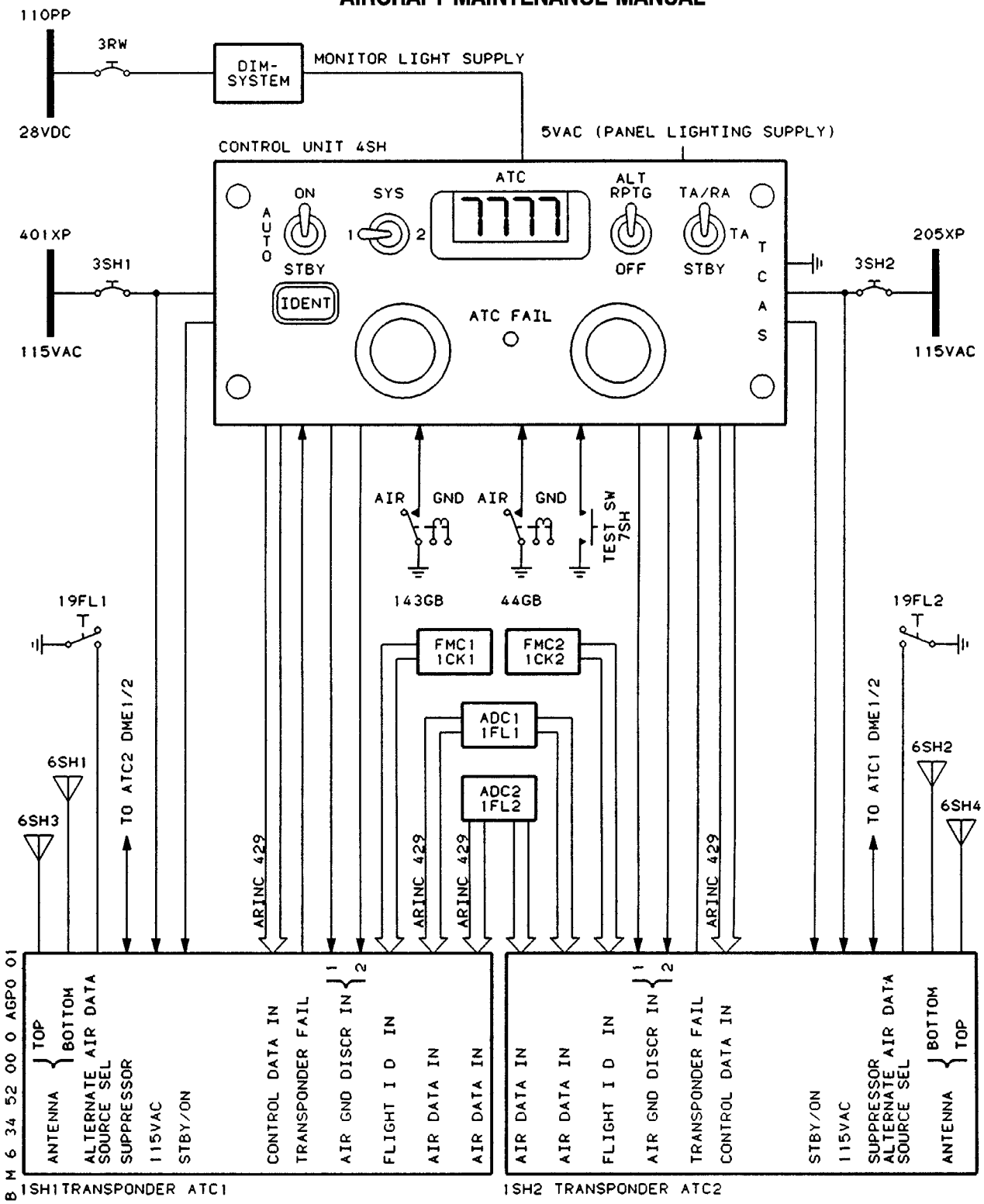
**ON A/C ALL

(4) If the TEST pushbutton is pressed and held, the BITE will continue to sequence thru the self test to indicate the present test result of test performed during the last four flight segments which are stored in the CPU memory.

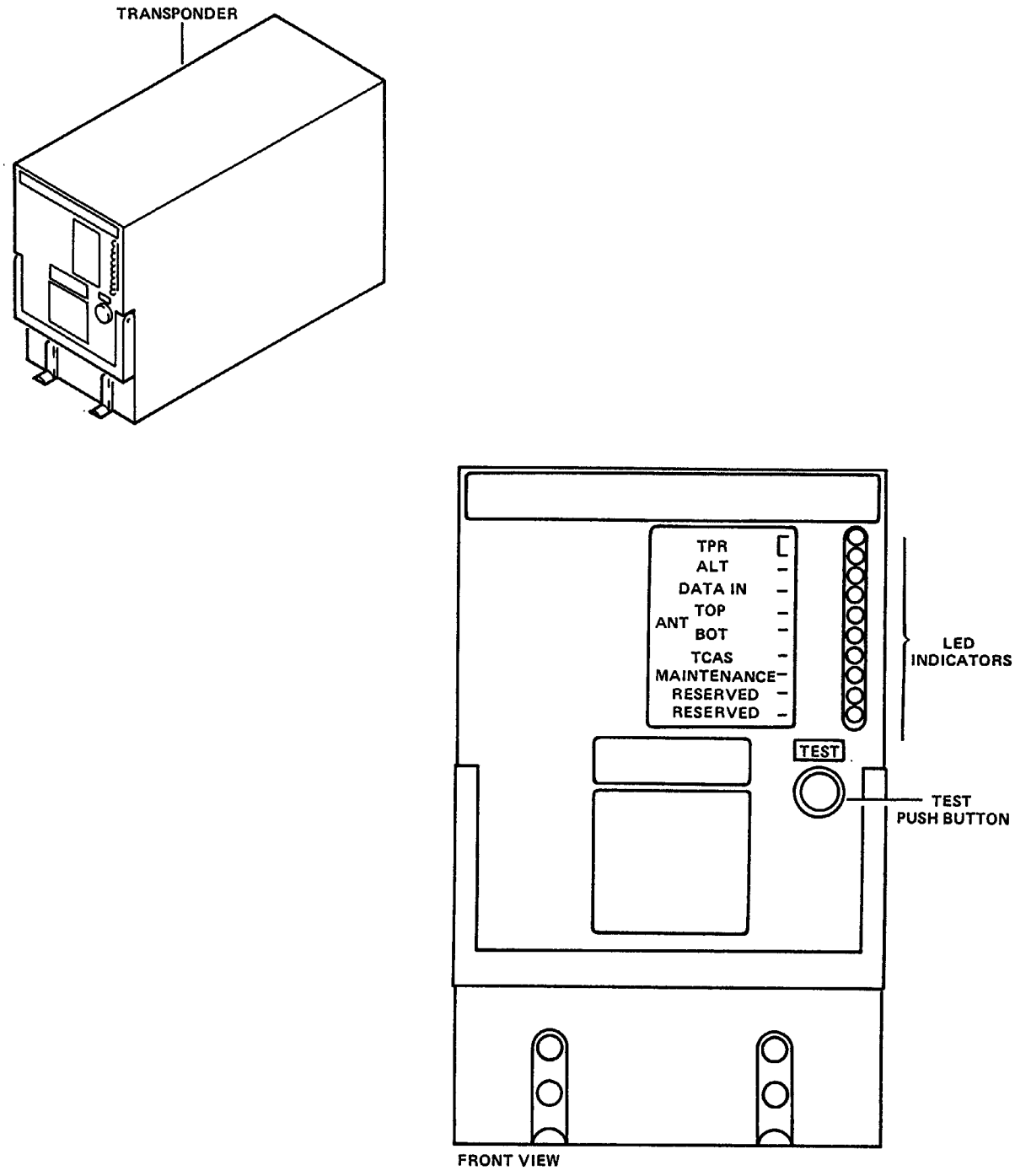
B. Display Test
Push annunciator light switch, on 436VU of overhead panel to TEST position. All characters from display of control unit are visible.



ATC - System Architecture Block Diagram
Figure 011



ATC - System Architecture Block Diagram
Figure 012



BM6 34 52 00 0 ANCO 00

ATC - Transponder
Figure 013

R 1. General

This maintenance practice provides procedure after a change of Aircraft Registration Number.

2. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
Referenced Procedure	
- AWM 34-52-05	Navigation ATC-1 ATC-2 Program Identification
- ESPM 20-44-00	Connectors, Terminal Blocks and Grounding Items

3. Procedure

A. Job Set-Up

R (1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM-ATC1	3SH1	107/C01
R 21VU	RADIO-NAV & COM-ATC2	3SH2	107/C14

(2)Open access door 121BL to gain access to avionics compartment.

B. Procedure to Change the ICAO Address

(1)Take the ICAO address and convert it into binary format.

(a)Find the plug to be pin-programmed (Ref. AWM 34-52-05).

(b)Connect the pin-programming according to the binary format of the ICAO address (Ref. ESPM 20-44-00).

Any pin to be coded "1" on the plug, must be connected to the common pin -B of the same plug.

R NOTE : Pin A of the plug is Most Significant Bit (MSB).

R NOTE : For example, ICAO address C0099D (hexadecimal)/60004635 (octal) must be converted into 1100 0000 0000 1001 1001 1101 (binary). Thus, you must connect pins A, B, N, S, T, W, X, Y and -A of the plug to pin -B (Ref. AWM 34-52-05).

R (2)Close circuit breakers.

C. Close-Up

(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

(2)Close access door 121BL.

1. Operational Test

A. Reason for the Job
(1)To ensure that the ATC transponder is operating correctly.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz

Referenced Procedure	
- 24-41-00, P. Block 301	AC External Power Control

C. Procedure
(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Make certain that the following circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ATC 1	3SH1	107/C 1
21VU	RADIO NAV & COM/ATC 2	3SH2	107/C14
21VU	NAVIGATION/ADS/ADC 2/115 V AC	9FL2	105/E10
21VU	RADIO NAV & COM/NAV CTL PNL LT AND SELCAL	3RW	106/D 6
22VU	MIN EQPT BAY SUPPLY/ADS/ADC 1/115 V AC	9FL1	208/B19
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77
132VU	LIGHTING/INT LT/ANN LT/DIM	197LT	324/L84
132VU	LIGHTING/INT LT/ANN LT/DIM	198LT	324/L83
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	149LP	324/L82
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	2LP	324/L81
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	1LP	324/L80

(d)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME 1	4SD1	107/C 4
21VU	RADIO NAV & COM/DME 2	4SD2	107/C11

R **ON A/C 101-200,

(e)On the ATC control unit 4SH place the rotary selector switch to ALT OFF, place the ATC 1/2 switch to 1 (2). The last selected code appears on the display.

NOTE : The test described below is for ATC 1. The ATC 2 is identical; for testing refer to information shown in brackets.

(2)Test

ACTION	RESULT
1. On the ATC control unit 4SH : - switch and hold the rotary selector switch in the TEST position.	On the ATC control unit 4SH : - the ATC FAIL lamp comes on for 3 s. - then the ATC FAIL lamp goes off, and the display shows 8888 until the rotary selector switch is released from the TEST position.

R **ON A/C 001-100,

(e)On the ATC control unit 4SH place the rotary selector switch to ALT OFF, place the ATC 1/2 switch to 1 (2). The last selected code appears on the display.

NOTE : The test described below is for ATC 1. The ATC 2 is identical; for testing refer to information shown in brackets.

(2)Test

ACTION	RESULT
1. On the ATC control unit 4SH : - switch and hold the rotary selector switch in the TEST position.	On the ATC control unit 4SH : - the ATC FAIL lamp comes on for 3 s. - then the ATC FAIL lamp goes off, and the display shows 8888 until the rotary selector switch is released from the TEST position.

R **ON A/C ALL

2. In the avionics compartment, in the electronics rack 500VU, on the ATC transponder 1 (2) front panel : - press and hold pushbutton TEST.	In the avionics compartment, in the electronics rack 500VU, on the ATC transponder 1 (2) front panel : - all LEDs come on for 3 seconds. - observe that all LEDs stay off for approximately 3 s. - then TPR green LED comes on until TEST pushbutton is released. - in case of failure the respective fail LEDs should appear.

R **ON A/C 101-200,

(3)Close-Up
(a)On the ATC control unit 4SH place the rotary selector switch to the STBY position.
(b)On the panel 21VU close circuit breakers 4SD1, location C 4 and 4SD2, location C11.
(c)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(d)Make certain that the working area is clean and clear of tools and miscellaneous items of equipment.

R **ON A/C 001-100,

(3)Close-Up
(a)On the ATC control unit 4SH place the rotary selector switch to the STBY position.
(b)On the panel 21VU close circuit breakers 4SD1, location C 4 and 4SD2, location C11.
(c)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(d)Make certain that the working area is clean and clear of tools and miscellaneous items of equipment.

R **ON A/C ALL

2. Functional Test with the ATC-601 Ramp Test Set or Equivalent

A. Reason for the Job
(1)To ensure correct operation of ATC system with the two antennas.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz
(2)	ATC-601 Ramp Test Set (or equivalent)
(3)	Shields for the ATC antennas (boot covers)
(4)	Ground Pressure Generator
(5)	Seals for the static probes

Referenced Procedures

- 24-41-00, P. Block 301	AC External Power Control
- 32-00-00, P. Block 501	Landing Gear General
- 34-10-00, P. Block 301	Flight Environment Data

C. Procedure

NOTE : If not otherwise recommended herein, do the subsequent tests with the aircraft in a hangar. This will help to reduce the chance of interference with other airborne air traffic by false alarms.

(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Make certain that the following circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ATC 1	3SH1	107/C 1
21VU	RADIO NAV & COM/ATC 2	3SH2	107/C14
21VU	NAVIGATION/ADS/ADC 2/115 V AC	9FL2	105/E10
21VU	RADIO NAV & COM/NAV CTL PNL LT AND SELCAL	3RW	106/D 6
22VU	MIN EQPT BAY SUPPLY/ADS/ADC 1/115 V AC	9FL1	208/B19
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77
132VU	LIGHTING/INT LT/ANN LT/DIM	197LT	324/L84
132VU	LIGHTING/INT LT/ANN LT/DIM	198LT	324/L83
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	149LP	324/L82
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	2LP	324/L81
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	1LP	324/L80

WARNING : SETTING TO FLIGHT CONFIGURATION CAN BE DANGEROUS FOR GROUND PERSONNEL AND FOR THE AIRCRAFT.

(d)Put the aircraft to Flight Configuration (Ref. 32-00-00, P. Block 501).
(e)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME 1	4SD1	107/C 4
21VU	RADIO NAV & COM/DME 2	4SD2	107/C11
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 FLT/GND	119GB	332/U52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 RELAYS & RETRACT CTL	2GB	332/U51
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 FLT/GND	1GB	331/V52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 GEAR DOWN & OVHD PNL/POS IND	83GB	331/V51

(f)Use the Ground Test Generator and do the subsequent steps of the Test of the ADC1 (ADC2) Pneumatic Circuit (Ref. 34-10-00, P. Block 501).
1 Start the ground pressure generator.
2 Connect the ground pressure generator to the CAPT side of the pitot/static probes.

3 Seal the opposite static probe.

(g)Place the ramp test set in the vicinity of the ATC 1 (ATC 2) antenna, according to the ramp test set operating instruction.

(h)Take the directional flat test set antenna from the hold and connect it to the ANTENNA connector of the test set.

(i)Put the ATC-601 Ramp Test Set in a line of sight position relative to the aircraft top antenna(s) of the ATC system, but stay as close to the aircraft as possible.

(j)Determine the height and distance between the aircraft antenna(s) and the ramp test set (Ref. Fig. 501).

(k)Shield the aircraft bottom antenna(s) of the ATC system with the boot cover(s) during the test of the top antenna.
(Ref. Fig. 501)

R **ON A/C 101-200,

(l)On the ATC control unit 4SH :
- turn the rotary selector switch to the ALT ON position,
- place the ATC 1/2 switch to 1 (2). The last selected code appears, on the display,
- use the left and right double control knobs and select the ATC code 5555 to minimize interference.

(m)Pressurize the Air Data System (ADS) with the ground pressure generator until an altitude of 10,000 ft. (STD) is displayed on the PFD (Ref. 34-10-00, P. Block 501).

NOTE : Pressurization of the Air Data System is not necessary when you do the automatic test sequence or the power test.

NOTE : The test described below is for ATC 1. The ATC 2 is identical; for testing refer to information shown in brackets.

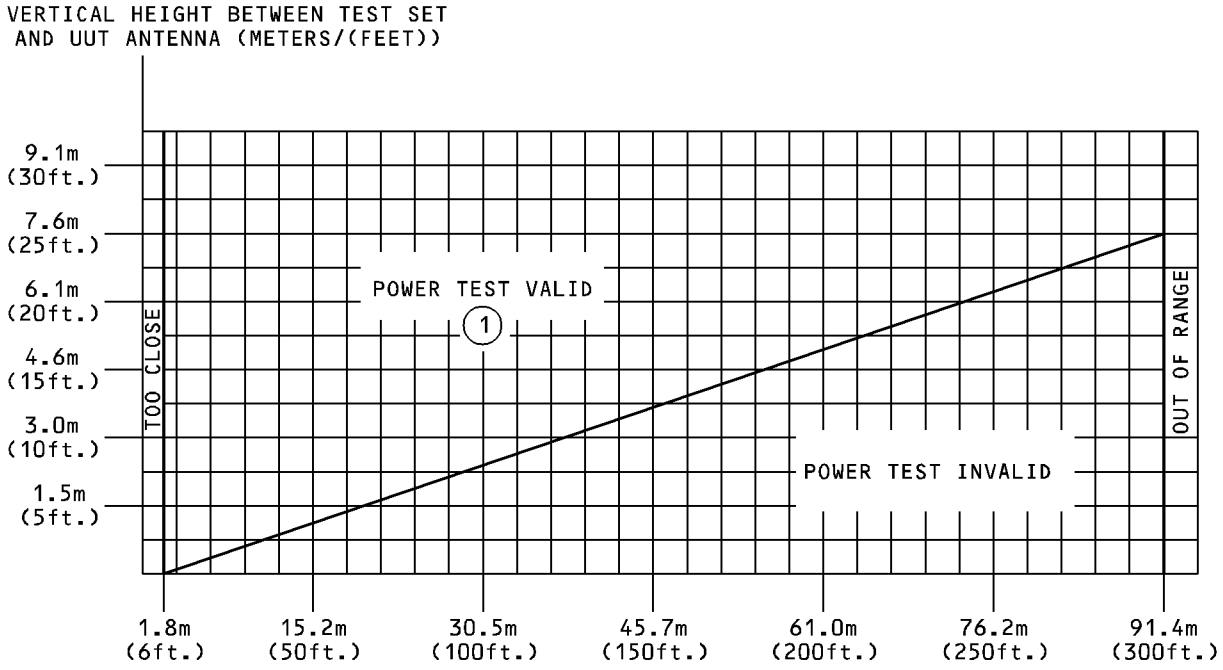
(2)Do this test with the ATC-601 Ramp Test Set

NOTE : Do the subsequent test of the ATC top antenna 1 (2) first with the antenna shield on the bottom antenna(s).
Then, do the test of the ATC bottom antenna 1 (2).
If it is not practical to shield the top antenna, the distance from the top antenna to the ATC-601 Ramp Test Set antenna has to be at least 2.5 times greater than from the bottom antenna.

(a)Automatic Test Sequence

R **ON A/C 001-100,

(l)On the ATC control unit 4SH :
- turn the rotary selector switch to the ALT ON position,
- place the ALT 1/2 switch to the 1 (2) position,
- place the ATC 1/2 switch to 1 (2). The last selected code appears, on the display,
- use the left and right double control knobs and select the ATC code



BM6 34 52 00 5 AAMO 01

(1) WHEN YOU USE THE TEST SET ON THE GROUND
IT IS RECOMMENDED TO HAVE A MINIMUM LINE
OF SIGHT DISTANCE OF APPROXIMATELY 30 METERS (100 FEET)
BETWEEN THE TEST SET AND THE TOP ANTENNA.
THE AIRCRAFT BODY IS NOT TO SHIELD THE TEST SET
FROM THE TOP ANTENNA.

ATC - Range/Height Reference Chart
Figure 501

5555 to minimize interference.

(m)Pressurize the Air Data System (ADS) with the ground pressure generator until an altitude of 10,000 ft. (STD) is displayed on the PFD (Ref. 34-10-00, P. Block 501).

NOTE : Pressurization of the Air Data System is not necessary when you do the automatic test sequence or the power test.

NOTE : The test described below is for ATC 1. The ATC 2 is identical; for testing refer to information shown in brackets.

(2)Do this test with the ATC-601 Ramp Test Set

NOTE : Do the subsequent test of the ATC top antenna 1 (2) first with the antenna shield on the bottom antenna(s).
Then, do the test of the ATC bottom antenna 1 (2).
If it is not practical to shield the top antenna, the distance from the top antenna to the ATC-601 Ramp Test Set antenna has to be at least 2.5 times greater than from the bottom antenna.

(a)Automatic Test Sequence

R **ON A/C ALL

ACTION	RESULT
1. On the ATC-601 Ramp Test Set : - make sure that the directional flat test set antenna is connected to the ANTENNA connector of the test set.	
2. On the ATC-601 Ramp Test Set : - push the POWER key.	On the ATC-601 Ramp Test Set : - the startup display of the unit is shown.
- push the SELF TEST key.	- the results of the last self test are displayed : ** SELF TEST - PASSED ** RF MODULE : PASSED DIGITAL MODULE : PASSED POWER SUPPLY/BATTERY : PASSED Press RUN to start
- push the RUN/STOP key to initiate a new test.	- the test starts and after a short while the test results are indicated.
- push the RUN/STOP key to stop the new test.	- the results of this new self test are displayed :

ACTION	RESULT
	(see above).
- verify that all modules passed the test.	
NOTE : If any module indication does not show PASSED, perform the related ATC-601 Ramp Test Set maintenance or use another unit and start again.	
NOTE : For the best power test results, there should be no other aircraft, vehicles, buildings or other large objects between the ATC-601 Ramp Test Set antenna and the aircraft with the Unit Under Test (UUT).	
3. On the ATC-601 Ramp Test Set : - push the SETUP key to enter the unit's SETUP MENU.	On the ATC-601 Ramp Test Set : - the display shows : ** SETUP MENU ** UUT ANTENNA : RANGE HEIGHT TOP = 44 18 BOTTOM = 30 6 SELECTED = BOTTOM GAIN_1030=11.5 GAIN_1090=12.0 LOSS=1.0
	NOTE : The indicated data is only an example. The new set-up data for the present conditions must be entered.
- enter the height and range of the UUT related antenna in feet. (Use the SLEW keys to change the values and the SELECT keys to change items. The cursor line indicates the selected item (position)).	
- use the SLEW keys to select the antenna under test for the subsequent test.	
- select the top (bottom) antenna.	
- push the SETUP key to exit the SETUP MENU.	
NOTE : The following steps should be performed in a fast sequence to minimize the danger of interference with other airborne air traffic.	
NOTE : During all subsequent test steps aim the directional flat test	

ACTION	RESULT
set antenna at the ATC antenna under test on the aircraft.	
4. On the ATC-601 Ramp Test Set : - push the AUTO TEST key to enter the AUTO TEST display.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
5. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	On the ATC-601 Ramp Test Set : - the display shows : ** AUTO TEST ** ********TEST RUNNING******** - after a short while : ** AUTO TEST - PASSED ** MODES TESTED - A, C, S FREQ=1090.00 MHz MODES PASSED - A, C, S ERP=53 dBm MODES FAILED - MTL=-73 dBm DIVERSITY ISOLATION shows in dBm Press RUN to start
6. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of this new test remain displayed : (see above). NOTE : The indicated data must be within the subsequent tolerances : - FREQ= 1090.00 (plus/minus 3) MHz. - ERP= 53 (plus/minus 4) dBm. - MTL= -73 (plus/minus 4) dBm.

R

(b)Manual Single Step Test Sequence

NOTE : This test sequence is necessary only if the automatic test sequence is not sufficient.

**ON A/C 101-200,

1 On the ATC control unit 4SH, make sure that :
- the rotary selector switch is in the ALT ON position,
- the ATC 1/2 switch is in the 1 (2) position,
- the display shows the code 5555.

**ON A/C 001-100,

1 On the ATC control unit 4SH, make sure that :
- the ALT 1/2 switch is in the 1 (2) position,
- the rotary selector switch is in the ALT ON position,
- the ATC 1/2 switch is in the 1 (2) position,
- the display shows the code 5555.

**ON A/C ALL

ACTION	RESULT
1. On the ATC-601 Ramp Test Set : push the right SELECT key (arrow down) to select the single step test.	On the ATC-601 Ramp Test Set :
- push the right SELECT key until the REPLY DELAY TEST page is shown.	- the display shows the results of the last test.
2. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test.	
- move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : ** REPLY DELAY TEST - PASSED ** MODE S: 128.00 us ITM A: 128.02 us C:128.04 us ATC A: 3.00 us C: 3.00 us Press RUN to start
3. On the handle of the directional flat test set antenna : - push the push button to	- the results of the new test remain

ACTION	RESULT
stop the test.	displayed : (see above).
	NOTE : The indicated data must be within the subsequent tolerances : - MODE S: 128.00 (plus/minus 0.25)us - ITM A : 128.00 (plus/minus 0.5)us - C : 128.00 (plus/minus 0.5)us - ATC A : 3.00 (plus/minus 0.5)us - C : 3.00 (plus/minus 0.5)us
4. On the ATC-601 Ramp Test Set: - push the right SELECT key until the REPLY JITTER TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
5. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : ** REPLY JITTER TEST - PASSED ** MODE S: 0.030 us ITM A: 0.050 us C: 0.050 us ATC A: 0.090 us C: 0.085 us Press RUN to start
6. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above). NOTE : The indicated data must be within the subsequent tolerances : - MODE S: equal or less than 0.08 us - ITM A: equal or less than 0.10 us C: equal or less than 0.10 us - ATC A: equal or less than 0.10 us C: equal or less than 0.10 us
7. On the ATC-601 Ramp Test Set : - push the right SELECT key until the ATCRBS REPLY	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.

ACTION	RESULT
TEST page is shown. NOTE : The results of the subsequent test step refer to Modes A and C of ATC modes of operation.	
8. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : ** ATCRBS REPLY TEST - PASSED ** F1 to F2 SPACING A:20.30us C:20.30us F1 PULSE WIDTH A: 0.45 us C: 0.45us F2 PULSE WIDTH A: 0.45 us C: 0.45us CODE= 5555 ALT= 10.000 FT Press RUN to start
9. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above). NOTE : The indicated data must be within the subsequent tolerances : - the F1 to F2 spacing is 20.30 (plus/minus 0.10) us - the F1 and F2 pulse width is 0.45 (plus/minus 0.10)us - the ALT value is according to the set-up. NOTE : The indicated ALT value is related to ATC Mode C. It must be compared with the altitude value indicated on the cockpit altimeter(s). The maximum allowable difference is 125 ft.
10. On the ATC-601 Ramp Test Set : - push the right SELECT key until the SLS LEVEL TEST page is shown.	On the ATC-601 Ramp Test Set: - the display shows the results of the last test.

ACTION	RESULT
11. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : **** SLS LEVEL TEST - PASSED **** -9 dB: REPLY 0 dB: NO REPLY Press RUN to start
12. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above). NOTE : The SLS LEVEL TEST must be done within 28.96 m (95 feet) of the UUT antenna.
13. On the ATC-601 Ramp Test Set : - push the right SELECT key until the ATC ONLY ALL-CALL TEST page is shown.	On the ATC-601 Ramp Test Set : the display shows the results of the last test.
14. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : **** ATC ONLY ALL-CALL TEST-PASSED **** PASSED TEST Press RUN to start
15. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed :

ACTION	RESULT
	(see above).
16. On the ATC-601 Ramp Test Set : - push the right SELECT key until the MODE S ALL-CALL TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
17. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : ** MODE S ALL-CALL TEST-PASSED ** ALL CALL ADDRESS = 3BD532 [XXXXXXXX] TAIL NUMBER = XXXXXX Press RUN to start
18. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above). NOTE : The indicated values in the places of XXXXXX represent aircraft specific data.
19. On the ATC-601 Ramp Test Set: - push the right SELECT key until the INVALID MODE S ADDRESS TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
20. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : ** INVALID ADDRESS TEST-PASSED ** PASSED TEST

ACTION	RESULT
	Press RUN to start.
21. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above).
22. On the ATC-601 Ramp Test Set: - push the right SELECT key until the SPR ON/OFF TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
23. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : **** SPR ON/OFF TEST - PASSED **** **SPR ON: REPLY** **SPR OFF: NO REPLY** Press RUN to start.
24. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above).
25. On the ATC-601 Ramp Test Set: - push the right SELECT key until the MODE S UFO TEST page is shown.	On the ATC-601 Ramp Test Set : the display shows the results of the last test.
26. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : **** MODE S UFO TEST - PASSED **** **DF 0 VS=0 RI=C AC=XXXXX FT**

ACTION	RESULT
	ADDRESS=3AC421 Press RUN to start
27. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above). NOTE : The indicated values in the places of XXXXXX represent the specific altitude data used presently.
28. On the ATC-601 Ramp Test Set : - push the right SELECT key until the MODE S UF4 TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
29. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : ** MODE S UF4 TEST - PASSED ** DF 4 FS=0 DR=00 UM=00 AC=XXXXX FT ADDRESS=3AC421 Press RUN to start.
30. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed: (see above). NOTE :The indicated values in the places of XXXXXX represent the specific altitude data used presently.
31.On the ATC-601 Ramp Test Set : - push the right SELECT key until the MODE S UF5 TEST page is	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.

ACTION	RESULT
shown.	
32. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : **** MODE S UF5 TEST - PASSED **** **DF 5 FS=0 DR=00 UM=00 ID=5555 ADDRESS=3AC421** **Press RUN to start.**
33. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above).
34. On the **ATC-601 Ramp Test Set** : - push the right **SELECT** key until the **MODE S UF11 TEST** page is shown.	On the **ATC-601 Ramp Test Set** : - the display shows the results of the last test.
35. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : **** MODE S UF11 TEST - PASSED **** **DF11 CA=1 AA=3AC421 PI=000000** **Press RUN to start.**
36. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above).
37. On the **ATC-601 Ramp Test Set** :	On the **ATC-601 Ramp Test Set** :

ACTION	RESULT
push the right SELECT key until the MODE S UF16 TEST page is shown.	- the display shows the results of the last test.
R 38. Hold the directional flat test R - set antenna at arm's length over your head, aim it and on its handle: R - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : ** MODE S UF16 TEST - PASSED ** DF16 VS=0 RI=0 AC=XXXXX FT MV=000000000000 ADDRESS=3AC421 NOTE: If TCAS is not installed or is set to STBY then NO REPLY is shown. NOTE : If TCAS is available and coordination reply is identified ; R1 = 3 and MV = 300000000000 Press RUN to start. NOTE:The indicated values in the places of XXXXXX represent the specific altitude data used presently.
39. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above).
40. On the ATC-601 Ramp Test Set : - push the right SELECT key until the MODE S UF20 TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
41. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test.	

ACTION	RESULT
- move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : Ignore these results
42. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above).
43. On the ATC-601 Ramp Test Set : - push the right SELECT key until the MODE S UF21 TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
44. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to R start the test.	
- move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : Ignore these results
45. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above).
46. On the ATC-601 Ramp Test Set : - push the right SELECT key until the SQUITTER TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
47. Hold the directional flat test set antenna at arm's length over your head, aim it R and on its handle: R - push the push button to R start the test.	
- move the antenna downward from the top position within approximately 2 seconds	- after a short while the display shows the new test results : ** SQUITTER TEST - PASSED **

ACTION	RESULT
to near the level of your ankles.	PERIOD =2.00 SECONDS TAIL NUMBER = XXXXX SQUITTER ADDRESS=3AC421 [XXXXXXXX] Press RUN to start.
48. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above). NOTE : The indicated data must be within the subsequent tolerances : - PERIODE = 0.8 to 2.4 SECONDS. NOTE : The indicated values in the places of XXXXX represent the aircraft data for this specific aircraft.
49. On the ATC-601 Ramp Test Set : - push the right SELECT key until the FREQUENCY TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
50. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds R to near the level of your R ankles.	- after a short while the display shows the new test results : ** FREQUENCY TEST - PASSED ** FREQUENCY = 1090.30 MHz. R Press RUN to start
R 51. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above). NOTE :The indicated data must be within the subsequent

ACTION	RESULT
	tolerances : - FREQ= 1090.00 (plus/minus 3) MHz.
52. On the ATC-601 Ramp Test Set : - push the right select key until the DIVERSITY TEST page is shown.	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.
53. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test.	
- move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : ** DIVERSITY TEST - PASSED ** DIVERSITY ISOLATION: 27 dB Press RUN to start. NOTE:The indicated data must be within the subsequent tolerances : - DIVERSITY ISOLATION = equal or more than 20 dB between antenna switches ON and OFF. - The RF power output from each antenna is measured alternatively. When power is 'ON' at one antenna, it is 'OFF' at the other antenna. NOTE:This test must be done within 15.24 m (50 feet) of the UUT antenna to insure the correct dynamic range.
54. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above).
55. On the ATC-601 Ramp Test Set: - push the right SELECT key until the MTL DIFFERENCE TEST	On the ATC-601 Ramp Test Set : - the display shows the results of the last test.

ACTION	RESULT
page is shown.	
56. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	- after a short while the display shows the new test results : **** MTL DIFFERENCE TEST-PASSED **** MODE A MTL-MODE C MTL = 0.2 dB Press RUN to start.
57. On the handle of the directional flat test set antenna : - push the push button to stop the test.	- the results of the new test remain displayed : (see above). NOTE : The indicated data must be within the subsequent tolerances : - equal or less than 1.0 dB.
58. On the ATC control unit 4SH :	
**ON A/C 101-200, - place the rotary selector switch in the ALT OFF position.	
**ON A/C 001-100, - place the rotary selector switch in the ALT OFF position.	
**ON A/C ALL	

(c)Power Test

NOTE : Make sure to use the same range/height set-up for this test as previously established with the range/height chart (Ref. Fig. 501).

NOTE : Do the subsequent test outside a hangar. Make sure that there are no obstacles between the test set-up and the aircraft. Make sure that there are no buildings, vehicles or other equipment in the near vicinity to cause unwanted reflections.

NOTE : The display on the test set shows the correct power reading only when the test set amtenna faces the UUT antenna from the correct range (Ref. Fig. 501).

**ON A/C 101-200,

1 On the ATC control unit 4SH, make sure that :
- the rotary selector switch is in the ALT ON position,
- the ATC 1/2 switch is in the 1 (2) position,
- the display shows the code 5555.

**ON A/C 001-100,

1 On the ATC control unit 4SH, make sure that :
- the ALT 1/2 switch is in the 1 (2) position,
- the rotary selector switch is in the ALT ON position,
- the ATC 1/2 switch is in the 1 (2) position,
- the display shows the code 5555.

**ON A/C ALL

ACTION	RESULT
1. On the ATC-601 Ramp Test Set : - make sure that the directional flat test set antenna is connected to the ANTENNA connector of the test set.	
2. On the aircraft : - shield the ATC bottom antenna(s) with a boot cover.	
3. With the directional flat test set antenna : - remain in the distance from the UUT as established for the previous test sequence.	
4. On the ATC-601 Ramp Test Set : - push the POWER TEST key.	On the ATC-601 Ramp Test Set : - the results of the last power test are displayed : ** POWER TEST **

ACTION	RESULT
	ERP MTL TOP AVG (dBm) = NOT RUN . BOT AVG (dBm) = 52.0 -74.3 INSTANTANEOUS = Press RUN to start
5. On the ATC-601 Ramp Test Set : - push the left or right SELECT key to select the top antenna.	On the ATC-601 Ramp Test Set : - the dot in front of TOP or BOT indicates which set of antennas has been selected.
6. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	On the ATC-601 Ramp Test Set : - after a short while the display shows for the top antenna : ** POWER TEST ** ERP MTL . TOP AVG (dBm) = BOT AVG (dBm) = NOT RUN INSTANTANEOUS = XX.X -XX.X Press RUN to start NOTE : The indicated values in the places of XX.X represent the specific data measured presently.
7. On the handle of the directional flat test set antenna : - push the push button to stop the power test.	On the ATC-601 Ramp Test Set : - the display shows for the top antenna : ** POWER TEST ** ERP MTL . TOP AVG (dBm) = XX.X -XX.X BOT AVG (dBm) = NOT RUN INSTANTANEOUS = Press RUN to start NOTE : The indicated values for the top antenna should be : - ERP: less than 57.0 dBm and more than 48.5 dBm - MTL:-73.0 (plus/minus 4.0) dBm.

ACTION	RESULT
8. On the aircraft : - remove the boot cover from the bottom antenna(s).	
9. On the aircraft : - shield the top antenna(s) with a boot cover. NOTE : If it is not practical to shield the top antenna, the distance from the top antenna to the ATC-601 Ramp Test Set antenna has to be at least 2.5 times greater than from the bottom antenna. For best results in this case the distance between the test set antenna and the UUT should be approximately 5 m (15.4 feet).	
10. With the ATC-601 Ramp Test Set : - move to get a clear view toward the aircraft ATC bottom antenna(s). - move into a position relative to the aircraft to meet the requirement in the NOTE above.	
11. On the ATC-601 Ramp Test Set : - push the left or right SELECT key to select the bottom antenna.	On the ATC-601 Ramp Test Set : - the dot in front of TOP or BOT indicates which set of antennas has been selected.
12. Hold the directional flat test set antenna at arm's length over your head, aim it and on its handle : - push the push button to start the test. - move the antenna downward from the top position within approximately 2 seconds to near the level of your ankles.	On the ATC-601 Ramp Test Set : - after a short while the display shows for the bottom antenna : ** POWER TEST ** ERP MTL TOP AVG (dBm) = NOT RUN . BOT AVG (dBm) = INSTANTANEOUS = XX.X -XX.X Press RUN to start NOTE : The indicated values in the places of XX.X represent the specific data measured presently.
13. On the handle of the directional flat test set antenna : - push the push button to	On the ATC-601 Ramp Test Set : - the display shows for the bottom

ACTION	RESULT
stop the power test.	antenna : ** POWER TEST ** ERP MTL TOP AVG (dBm) = NOT RUN . BOT AVG (dBm) = XX.X -XX.X INSTANTANEOUS = Press RUN to start NOTE : The indicated values for the bottom antenna should be : - ERP: less than 57.0 dBm and more than 48.5 dBm - MTL:-73.0 (plus/minus 4.0) dBm.

14. On the ATC-601 Ramp Test Set :
    - push the **POWER** key to switch the set off.

**ON A/C 101-200,

(d)On the ATC control unit 4SH place the ATC 1/2 switch to 2.
(e)Remove the seal from the static probe.
(f)Seal the opposite static probe.
(g)Do the functional test again for the ATC2.

(4)Close-Up
(a)On the ATC-601 Ramp Test Set :
1 Disconnect the antenna from the Ramp Test Set
2 Remove the Ramp Test Set.
(b)Remove the boot cover from the antenna(s).
(c)On the ATC control unit 4SH place the rotary selector switch to STBY.
(d)Depressurize the ADS on the ground pressure generator (Ref. 34-10-00, P. Block 501).
(e)Remove the seal(s) from the static probe(s).
(f)Stop the ground pressure generator.
(g)Disconnect the ground pressure generator from the aircraft probes (Ref. 34-10-00, P. Block 501).
(h)Close the circuit breakers 4SD1, 4SD2, 119GB, 2GB, 1GB and 83GB.
(j)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(k)Remove the ATC-601 Ramp Test Set.
(l)Make certain that the working area is clean and clear of tools and miscellaneous items of equipment.

**ON A/C 001-100,

(d)On the ATC control unit 4SH place the ATC 1/2 switch to 2.
(e)Remove the seal from the static probe.
(f)Seal the opposite static probe.
(g)Do the functional test again for the ATC2.

(4)Close-Up
(a)On the ATC-601 Ramp Test Set :
1 Disconnect the antenna from Ramp Test Set
2 Remove the Ramp test Set.
(b)Remove the boot cover from the antenna(s).
(c)On the ATC control unit 4SH place the rotary selector switch to STBY.
(d)Depressurize the ADS on the ground pressure generator (Ref. 34-10-00, P. Block 501).
(e)Remove the seal(s) from the static probe(s).
(f)Stop the ground pressure generator.
(g)Disconnect the ground pressure generator from the aircraft probes (Ref. 34-10-00, P. Block 501).
(h)Close the circuit breakers 4SD1, 4SD2, 119GB, 2GB, 1GB and 83GB.
(j)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(k)Remove the ATC-601 Ramp Test Set.
(l)Make certain that the working area is clean and clear of tools and miscellaneous items of equipment.

**ON A/C ALL

3. Functional Test with the Ramp Test Set TIC, T-49

A. Reason for the Job
(1)To ensure correct operation of ATC system with the two antennas.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz
(2)	Ramp Test Set (TIC, T-49, ATCRBS/Mode S)
(3)	Shields for the ATC antennas (boot covers)
(4)	Ground Pressure Generator
(5)	Seals for the static probes

Referenced Procedures

- 24-41-00, P. Block 301	AC External Power Control
- 32-00-00, P. Block 501	Landing Gear General
- 34-10-00, P. Block 301	Flight Environment Data

C. Procedure

NOTE : If not otherwise recommended herein, do the subsequent tests with the aircraft in a hangar. This will help to reduce the

chance of interference with other airborne air traffic by false alarms.

(1)Job Set-Up

(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(b)Make certain that electronics racks ventilation is correct.

(c)Make certain that the following circuit breakers are closed :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ATC 1	3SH1	107/C 1
21VU	RADIO NAV & COM/ATC 2	3SH2	107/C14
21VU	NAVIGATION/ADS/ADC 2/115 V AC	9FL2	105/E10
21VU	RADIO NAV & COM/NAV CTL PNL LT AND SELCAL	3RW	106/D 6
22VU	MIN EQPT BAY SUPPLY/ADS/ADC 1/115 V AC	9FL1	208/B19
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77
132VU	LIGHTING/INT LT/ANN LT/DIM	197LT	324/L84
132VU	LIGHTING/INT LT/ANN LT/DIM	198LT	324/L83
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	149LP	324/L82
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	2LP	324/L81
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	1LP	324/L80

WARNING : SETTING TO FLIGHT CONFIGURATION CAN BE DANGEROUS FOR GROUND PERSONNEL AND FOR THE AIRCRAFT.

(d)Put the aircraft to Flight Configuration (Ref. 32-00-00, P. Block 501).

(e)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME 1	4SD1	107/C 4
21VU	RADIO NAV & COM/DME 2	4SD2	107/C11
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 FLT/GND	119GB	332/U52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 RELAYS & RETRACT CTL	2GB	332/U51
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 FLT/GND	1GB	331/V52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 GEAR DOWN & OVHD PNL/POS IND	83GB	331/V51

(f)Use the Ground Test Generator and do the subsequent steps of the Test of the ADC1 (ADC2) Pneumatic Circuit (Ref. 34-10-00, P. Block 501).

1 Start the ground pressure generator.

2 Connect the ground pressure generator to the CAPT side of the pitot/static probes.

3 Seal the opposite static probe.

(g)Place the ramp test set in the vicinity of the ATC 1 (ATC 2) antenna,

according to the TIC, T-49 ramp test set operating instruction.

1 Operators that do not use the antenna coupler TAP125, proceed as follows :

a Take the short omnidirectional antenna from the hold and connect it to the ANTENNA connector.

b Put the ramp test set in a position 50 ft to 100 ft from the aircraft ATC top antenna(s).

c Shield the aircraft bottom antenna(s) of the ATC system with the boot cover(s) during the test of the top antenna.

(h)Operators that use the antenna coupler TAP125, proceed as follows:

1 Put the antenna coupler in position over the antenna to be tested.

NOTE: The antenna coupler must be centered over the antenna base and placed such that EMI gasket material is compressed against the skin of the aircraft.

2 Connect the cable of the antenna coupler to the Ramp Test Set.

**ON A/C 101-200,

(i)On the ATC control unit 4SH :
- turn the rotary selector switch to the ALT ON position,
- place the ATC 1/2 switch to 1 (2). The last selected code appears, on the display,
- use the left and right double control knobs and select the ATC code 5555 to minimize interference.

**ON A/C 001-100,

(i)On the ATC control unit 4SH :
- turn the rotary selector switch to the ALT ON position,
- place the ALT 1/2 switch to the 1 (2) position,
- place the ATC 1/2 switch to 1 (2). The last selected code appears, on the display,
- use the left and right double control knobs and select the ATC code 5555 to minimize interference.

**ON A/C ALL

(j)Pressurize the Air Data System (ADS) with the ground pressure generator until an altitude of 10,000 ft. (STD) is displayed on the PFD (Ref. 34-10-00, P. Block 501).

(k)Enter the flight number through the MCDU (Ref. 34-60-00, P. Block 1).

NOTE : The test described below is for ATC 1. The ATC 2 is identical; for testing refer to information shown in brackets.

(2)Test with ramp test set TIC, T-49

NOTE : Do the subsequent test of the ATC top antenna 1 (2) first with

the antenna shield on the bottom antenna(s).
Then, do the test of the ATC bottom antenna 1(2).
If it is not practical to shield the top antenna, the distance from the top antenna to the ramp test set TIC, Tel-Instrument, T-49 antenna has to be significantly greater than from the bottom antenna. Also the aircraft body should shield the line of sight between the ramp test set and the aircraft TCAS top antenna(s).

ACTION	RESULT
1. On the ramp, on the ramp test set : - turn the **ATCRBS/MODE S/TCAS/ XPDR TEST** rotary switch to the **XPDR TEST** position.	
2. On the ramp, on the ramp test set : - push the **TEST** pushbutton to energize the ramp test set.	On the ramp, on the ramp test set: - the data display indicates **MODE S XPDR Com A/B** Interrogate to test
3. On the ramp, on the ramp test set : - push the **TEST** pushbutton.	On the ramp, on the ramp test set: - the data display indicates **ATCRBS/A** **TESTING** - the data display indicates **ATCRBS/A** **5555** xx% Reply (xx is a number indicating the local conditions of reception).

NOTE : The following steps should be performed in a fast sequence to minimize danger of interference by false alarms with other airborne air traffic.

**ON A/C 101-200,

4. On the ATC control unit 4SH :
   - place the rotary selector switch to the **ALT ON** position.

**ON A/C 001-100,

4. On the ATC control unit 4SH :
   - place the ALT 1/2 switch to 1 (2),
   - place the rotary selector switch to the **ALT ON** position.

ACTION	RESULT
**ON A/C ALL	
5. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates ATCRBS/C TESTING - the data display indicates ATCRBS/C y,yyy ft xx% Reply (y,yyy is 10,000) NOTE : The difference between the indicated altitude on the ramp test set and on the altimeter(s) in the cockpit must not be more than 125 ft.
6. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates ATCRBS/A MODE S ALL TESTING - the data display indicates ATCRBS/A MODE S ALL aircraft code xx% Reply (aircraft code is in 6 digits)
7. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates ATCRBS/C MODE S ALL TESTING - the data display indicates ATCRBS/C MODE S ALL aircraft code xx% Reply
8. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates ATCRBS/A only TESTING - the data display indicates ATCRBS/A only No Reply From XPDR
9. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates ATCRBS/C only TESTING - the data display indicates ATCRBS/C only

ACTION	RESULT
	No Reply From XPDR
10. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates Mode S Surv Identity TESTING - the data display indicates Mode S Surv Altitude TESTING - the data display indicates Mode S Surv Short TESTING - the data display indicates Mode S Surv xx% Reply and aircraft code and 10,000 ft.
11. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : possibly either - the data display indicates Mode S Comm Identity TESTING - the data display indicates Mode S Comm Altitude TESTING or - the data display indicates Mode S Comm Identity TESTING - the data display indicates Mode S Comm Altitude TESTING - the data display indicates Mode S Comm Short TESTING in all cases - the data display indicates Mode S Comm xx% Reply aircraft code and 10,000 ft. - the data display indicates Undesired Replies TESTING

ACTION	RESULT
	(only for a short moment, then blinks off for a short moment) - the data display indicates Undesired Replies No Replies
12. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates Squitter TESTING - the data display indicates Squitter PASS
13. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates Max True Airspeed - the data display indicates Max True Airspeed GT 300 & LE 600 kts
14. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates Flight No. TESTING - the data display indicates Flight No. 12345678 NOTE : Test set T-49 must have upgraded software installed to test and display the aircraft flight number. When the T-49 does not have the upgrade installed, the procedure will go from step 13 to step 15. The same applies if a Smith FMS-system is installed, which also does not display the flight number.
15. On the ramp, on the ramp test set : - push the TEST pushbutton.	On the ramp, on the ramp test set : - the data display indicates Pwr. Rcvr. Freq TESTING - the data display indicates 1090 ±3 MHz 125-500 W -74 ±3 dBm

ACTION	RESULT

**ON A/C 101-200,

16. On the ATC control unit 4SH :
- place the rotary selector switch to the ALT OFF position.

**ON A/C 001-100,

16. On the ATC control unit 4SH :
- place the rotary selector switch to the ALT OFF position.

**ON A/C 101-200,

(a)On the ATC control unit 4SH place the ATC 1/2 switch to 2.
(b)Remove the seal from the static probe.
(c)Seal the opposite static probe.
(d)Do the functional test again for the ATC2.

(4)Close-Up
(a)On the Ramp Test Set :
1 If antenna was used, disconnect it from Ramp Test Set.
2 If antenna coupler was used, disconnect the cable from the Ramp Test Set and carefully remove the antenna coupler from the related antenna.
(b)Remove the boot cover from the antenna(s).
(c)On the ATC control unit 4SH, place the rotary selector switch to STBY.

**ON A/C 001-100,

(a)On the ATC control unit 4SH place the ATC 1/2 switch to 2.
(b)Remove the seal from the static probe.
(c)Seal the opposite static probe.
(d)Do the functional test again for the ATC2.

(4)Close-Up
(a)On the Ramp Test Set :
1 If antenna was used, disconnect it from Ramp Test Set.
2 If antenna coupler was used, disconnect the cable from the Ramp Test Set and carefully remove the antenna coupler from the related antenna.
(b)Remove the boot cover from the antenna(s).
(c)On the ATC control unit 4SH, place the rotary selector switch to STBY.

**ON A/C ALL

(d)Depressurize the ADS on the ground pressure generator (Ref. 34-10-00, P. Block 501).
(e)Remove the seal(s) from the static probe(s).

(f)Stop the ground pressure generator.
(g)Disconnect the ground pressure generator from the aircraft probes (Ref. 34-10-00, P. Block 501).
(h)Close the circuit breakers 4SD1, 4SD2, 119GB, 2GB, 1GB and 83GB.
(i)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(j)Remove the Ramp Test Set.
(k)Make certain that the working area is clean and clear of tools and miscellaneous items of equipment.

**ON A/C ALL

4. Functional Test of Air Traffic Control (ATC) Mode S

A. Reason for the Job

(1)There are alternative methods for this procedure. This task gives one
R of the methods. For the other method with a different ground test unit, refer to the other test.
R (2)To do a functional test of ATC Mode S for Elementary Surveillance.
R (3)To do a functional test of ATC Mode S for Enhanced Surveillance.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz
R (2)	Mode S/ATCRB System Test Set (with ELS/EHS
R	Functions) and User Manual
R (3)	Access Platform 7.90 m (26 ft.)

Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 32-00-00, P. Block 501	Landing Gear General
- 34-10-00, P. Block 301	Flight Environment Data
- 34-60-00, P. Block 001	Flight Management System

C. Procedure

NOTE : If not otherwise recommended herein, do the subsequent tests with the aircraft in a hangar. This will help to reduce the chance of interference with other airborne air traffic by false alarms.

(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

(b)Make certain that electronics racks ventilation is correct.

**ON A/C ALL

R (c)Make certain that the following circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ATC 1	3SH1	107/C 1
21VU	RADIO NAV & COM/ATC 2	3SH2	107/C14
21VU	NAVIGATION/ADS/ADC 2/115 V AC	9FL2	105/E10
21VU	RADIO NAV & COM/NAV CTL PNL LT AND SELCAL	3RW	106/D 6
22VU	MIN EQPT BAY SUPPLY/ADS/ADC 1/115 V AC	9FL1	208/B19
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77
132VU	LIGHTING/INT LT/ANN LT/DIM	197LT	324/L84
132VU	LIGHTING/INT LT/ANN LT/DIM	198LT	324/L83
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	149LP	324/L82
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	2LP	324/L81
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	1LP	324/L80

R WARNING : SETTING TO FLIGHT CONFIGURATION CAN BE DANGEROUS FOR GROUND
R PERSONNEL AND FOR THE AIRCRAFT.

R (d)Put the aircraft to flight configuration (Ref. 32-00-00,
R P. Block 501).

R (e)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME 1	4SD1	107/C 4
21VU	RADIO NAV & COM/DME 2	4SD2	107/C11
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 FLT/GND	119GB	332/U52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 RELAYS & RETRACT CTL	2GB	332/U51
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 FLT/GND	1GB	331/V52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 GEAR DOWN & OVHD PNL/POS IND	83GB	331/V51

R (f)Position access platform.
R (g)Place Mode S/ATCRB system test set in the vicinity of ATC 1(2)
R antenna.
R (h)Make certain that the test set is in correct condition.
R (j)Connect the test antenna to the test set.
R (k)Put the test antenna in position in the line of sight of ATC1(2)
R bottom antenna only.

R (l)On center pedestal, on ATC control unit 4SH:
R - turn rotary selector TEST/STBY/ALT OFF/ALT ON/TA/TA/RA or

R STBY/XPDR/TA/RA/TA or TEST/STBY/XPDR/TA/RA/TA to ALT ON or XPDR
R position,
R - place ALT RPTG/1/OFF/2 switch to 1 or 2 position (if fitted),
R - place ALT 1/2 selector switch to 1(2) position (if fitted),
R - place ATC 1/2 or XPDR 1/2 selector switch to 1(2) position. The
R last selected code appears on the display,
R - use left and right double control knobs or use the code select
R keypad and select ATC code 7776 or a different code given by your
R local authorities, to keep traffic interference to a minimum.
R (m)Enter flight number through FMS CDU 1(2) (Ref. 34-60-00, P. Block 1).

R (2)Do this test with the Mode S/ATCRB System Test Set

R NOTE : Do the test for system 1. Then, do the test for system 2.

R NOTE : There are many different types of test benches. This procedure
R gives a typical test sequence. The test sequence can change with
R the test bench used.

R NOTE : For Elementary Surveillance and Enhanced Surveillance capable
R transponders, use an Elementary Surveillance and Enhanced
R Surveillance capable test set.

R NOTE : You can do this test automatically if:
R - You use a test set that has the automatic test function.
R - You make certain that the automatic test procedure does a test
R of all the parameters given in this procedure.

**ON A/C 001-003, 101-200,

ACTION	RESULT
1. Set test set (or bench) for:	Test set must show:
- Interrogation MODE A	- MODE A code: 7776, or code given by local authorities (see para. C.(1)(l)).
- Interrogation MODE A ONLY (ATCRBS - Mode A Only).	- No reply or PASS or OK.
2. Set test set (or bench) for:	Test set must show:
- Interrogation MODE C	- MODE C code: Z,ZZZ ft (Z,ZZZ is a number that gives approximately local field elevation).
- Interrogation MODE C ONLY (ATCRBS - Mode C Only).	- No reply or PASS or OK.
3. Set test set (or bench) for:	Test set must show:
- Interrogation MODE S	- MODE S aircraft code: XXXXXX

ACTION	RESULT
	(aircraft code has 6 digits and agrees with 24-bit Mode S address). - MODE A in DF 5 format. - MODE C in DF 4 format. - Flight number/Flight ID. - Acquisition Squitters (PERIOD is between 0.8 second and 2.4 seconds in DF 11 format). - Aircraft status: Flight or Air.
4. Set test set (or bench) for: - Side Lobe Suppression (SLS) test	Test set must show:
- SLS: -9 dB	- MODE A: 7776 or code given by local authorities (see para. 3) or PASS. - MODE C: Z,ZZZ (or PASS)
- SLS: 0 dB	- MODE A: no reply or PASS. - MODE C: no reply or PASS.
5. Set test set (or bench) for: - INVALID ADDRESS/UNDESIRED REPLY MODE S test.	Test set must show: - MODE S ADDRESS: no reply (or PASS).
6. On center pedestal, on ATC control unit 4SH: - Push ATC IDENT or IDENT or IDNT pushbutton switch.	On test set:
Set test set (or bench) for: - Interrogation in MODE A	- Ident pulse is transmitted for a minimum of 20 seconds.
7. Set test set (or bench) for: - Antenna diversity test.	On test set: - Antenna diversity or isolation must be more than or equal to 20 dB.
NOTE : Refer to diversity testing procedure given in test-bench user manual	
8. Set test set (or bench) for: - POWER test	On test set: - POWER must be more than or equal to 125 Watts and less than or equal to 500 Watts.
- FREQUENCY test	- FREQUENCY must be 1090 MHZ plus

ACTION	RESULT
	or minus 1 MHZ.
- SENSITIVITY test	- SENSITIVITY or MTL must be 74 dBm plus or minus 3 dBm.
- SENSITIVITY difference MODE A/MODE C test.	- SENSITIVITY difference must be less than or equal to 1 dB.

NOTE : To measure ATC 1(2) power and ATC 1(2) sensitivity, test antenna must be:
- In the line of sight of ATC 1(2) bottom antenna
- Then in the line of sight of ATC 1(2) top antenna.

You must enter the distance between ATC antennas and test antenna in set up menu of test set.
This distance is different for bottom antenna and top antenna of ATC transponder on which you do the test. You must measure distance with precision. If not, results of power test and sensitivity test will be unsatisfactory.
For more information, refer to User Manual of your test set.

9. On panel 21VU close circuit breakers:
   - RADIO NAV & COM/DME 1 (4SD1), location C4
   - RADIO NAV & COM/DME 2 (4SD2), location C11.

10. On panel 133VU close circuit breakers:
    - HYDRAULIC/L/G PROX DET & RELAYS SYS 1/FLT/GND (119GB), location U52
    - HYDRAULIC/L/G PROX DET & RELAYS SYS 1/RELAYS & RETRACT CTL (2GB), location U51
    - HYDRAULIC/L/G PROX DET & RELAYS SYS 2/FLT/GND (1GB), location V52
    - HYDRAULIC/L/G PROX DET & RELAYS SYS 2/GEAR DOWN & OVHD PNL/POS IND (83GB), location V51.

11. Set test set (or bench) for:	Test set must show:
- Interrogation MODE A	- MODE A: no reply
- Interrogation MODE C	- MODE C: no reply
- Interrogation MODE S	- MODE S aircraft code: XXXXXX
	- Flight number/Flight ID
	- Aircraft status: Ground.

**ON A/C 004-100,

ACTION	RESULT
1. Set test set (or bench) for: - Interrogation MODE A	Test set must show: - MODE A code: 7776, or code given by local authorities (see para. C.(1)(l)).
- Interrogation MODE A ONLY (ATCRBS - Mode A Only).	- No reply or PASS or OK.
2. Set test set (or bench) for: - Interrogation MODE C	Test set must show: - MODE C code: Z,ZZZ ft (Z,ZZZ is a number that gives approximately local field elevation).
- Interrogation MODE C ONLY (ATCRBS - Mode C Only).	- No reply or PASS or OK.
3. Set test set (or bench) for: - Interrogation MODE S	Test set must show: - MODE S aircraft code: XXXXXX (aircraft code has 6 digits and agrees with 24-bit Mode S address). - MODE A in DF 5 format. - MODE C in DF 4 format. - Flight number/Flight ID. - Acquisition Squitters (PERIOD is between 0.8 second and 2.4 seconds in DF 11 format). - Aircraft status: Flight or Air.
4. Set test set (or bench) for: - Side Lobe Suppression (SLS) test	Test set must show:
- SLS: -9 dB	- MODE A: 7776 or code given by local authorities (see para. 3) or PASS. - MODE C: Z,ZZZ (or PASS)
- SLS: 0 dB	- MODE A: no reply or PASS. - MODE C: no reply or PASS.
5. Set test set (or bench) for: - INVALID ADDRESS/UNDESIRED REPLY MODE S test.	Test set must show: - MODE S ADDRESS: no reply (or PASS).
6. On center pedestal, on ATC	Test set must show:

ACTION	RESULT
control unit 4SH: - Set ALT RPTG/ON/OFF switch to OFF.	
Set test set (or bench) for: - Interrogation in MODE C.	- MODE C: no Altitude Value.
7. On center pedestal, on ATC control unit 4SH: - Set ALT RPTG/ON/OFF switch to ON.	On test set:
- Push ATC IDENT or IDENT or IDNT pushbutton switch.	
Set test set (or bench) for: - Interrogation in MODE A	- Ident pulse is transmitted for a minimum of 20 seconds.
8. Set test set (or bench) for: - Antenna diversity test.	On test set: - Antenna diversity or isolation must be more than or equal to 20 dB.
9. Set test set (or bench) for: - POWER test	On test set: - POWER must be more than or equal to 125 Watts and less than or equal to 500 Watts.
- FREQUENCY test	- FREQUENCY must be 1090 MHZ plus or minus 1 MHZ.
- SENSITIVITY test	- SENSITIVITY or MTL must be 74 dBm plus or minus 3 dBm.
- SENSITIVITY difference MODE A/MODE C test.	- SENSITIVITY difference must be less than or equal to 1 dB.

NOTE : Refer to diversity testing procedure given in test-bench user manual

NOTE : To measure ATC 1(2) power and ATC 1(2) sensitivity, test antenna must be:
- In the line of sight of ATC 1(2) bottom antenna
- Then in the line of sight of ATC 1(2) top antenna.

You must enter the distance between ATC antennas and test antenna in set up menu of test set.
This distance is different for bottom antenna and top antenna of ATC transponder on which you do the test. You must measure distance with precision. If not, results of power test and sensitivity test will be unsatisfactory.
For more information, refer to User Manual of your test set.

ACTION	RESULT
10. On panel 21VU close circuit breakers: - RADIO NAV & COM/DME 1 (4SD1), location C4 - RADIO NAV & COM/DME 2 (4SD2), location C11.	
11. On panel 133VU close circuit breakers: - HYDRAULIC/L/G PROX DET & RELAYS SYS 1/FLT/GND (119GB), location U52 - HYDRAULIC/L/G PROX DET & RELAYS SYS 1/RELAYS & RETRACT CTL (2GB), location U51 - HYDRAULIC/L/G PROX DET & RELAYS SYS 2/FLT/GND (1GB), location V52 - HYDRAULIC/L/G PROX DET & RELAYS SYS 2/GEAR DOWN & OVHD PNL/POS IND (83GB), location V51.	
12. Set test set (or bench) for: - Interrogation MODE A - Interrogation MODE C - Interrogation MODE S	Test set must show: - MODE A: no reply - MODE C: no reply - MODE S aircraft code: XXXXXX - Flight number/Flight ID - Aircraft status: Ground.

**ON A/C ALL

(3)Do the Functional Test of the ATC MODE S for Elementary Surveillance.

NOTE : Put the test antenna in position in the line of sight of ATC1(2) bottom antenna only.

(a)Make certain that the following circuit breakers are closed:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ATC 1	3SH1	107/C 1
21VU	RADIO NAV & COM/ATC 2	3SH2	107/C14
21VU	NAVIGATION/ADS/ADC 2/115 V AC	9FL2	105/E10
21VU	RADIO NAV & COM/NAV CTL PNL LT AND SELCAL	3RW	106/D 6
22VU	MIN EQPT BAY SUPPLY/ADS/ADC 1/115 V AC	9FL1	208/B19
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77
132VU	LIGHTING/INT LT/ANN LT/DIM	197LT	324/L84
132VU	LIGHTING/INT LT/ANN LT/DIM	198LT	324/L83

PANEL	SERVICE	IDENT.	LOCATION
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	149LP	324/L82
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	2LP	324/L81
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	1LP	324/L80

WARNING : SETTING TO FLIGHT CONFIGURATION CAN BE DANGEROUS FOR GROUND PERSONNEL AND FOR THE AIRCRAFT.

(b)Put the aircraft to flight configuration (Ref. 32-00-00, P. Block 501).

(c)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME 1	4SD1	107/C 4
21VU	RADIO NAV & COM/DME 2	4SD2	107/C11
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 FLT/GND	119GB	332/U52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 RELAYS & RETRACT CTL	2GB	332/U51
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 FLT/GND	1GB	331/V52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 GEAR DOWN & OVHD PNL/POS IND	83GB	331/V51

(d)Test for Elementary Surveillance:

ACTION	RESULT
1. Set test set (or bench) for the Capability Report Comm B Data (Binary Data Stores (BDS 1.0)) test:	Test set must show:
- Surveillance Identifier (SI code test)	- PASS or OK or YES.
- A/C Ident capability	- PASS or OK or YES.
2. Set test set (or bench) for the Capability Report Comm B Data (BDS 1.7) test	Test set must show: - No null coding or PASS.
3. Set test set (or bench) for the Capability Report Comm B Data (BDS 3.0) test:	Test set must show:
- Resolution Advisory (RA) test	- No RA or Pass or OK.

R 4. On panel 21VU close circuit
R breakers:
R - RADIO NAV & COM/DME 1 (4SD1),
R location C4
R - RADIO NAV & COM/DME 2 (4SD2),
R location C11.

R 5. On panel 133VU close circuit
R breakers:
R - HYDRAULIC/L/G PROX DET & RELAYS
R SYS 1/FLT/GND (119GB),
R location U52
R - HYDRAULIC/L/G PROX DET & RELAYS
R SYS 1/RELAYS & RETRACT CTL
R (2GB), location U51
R - HYDRAULIC/L/G PROX DET & RELAYS
R SYS 2/FLT/GND (1GB),
R location V52
R - HYDRAULIC/L/G PROX DET & RELAYS
R SYS 2/GEAR DOWN & OVHD PNL/POS
R IND (83GB), location V51.

**ON A/C 105-200,

R (4)Do the Functional Test of the ATC MODE S for Enhanced Surveillance.

R NOTE : The verification of Enhanced Surveillance functionality is
R focused on one parameter per BDS, and one parameter from each
R source (FCU, ADC, IRS).

R NOTE : Put the test antenna in position in the line of sight of
R ATC1(2) bottom antenna only.

**ON A/C ALL

Post SB 34-2190 For A/C ALL

R (a)Make certain that the following circuit breakers are closed:

	PANEL	SERVICE	IDENT.	LOCATION
R	21VU	RADIO NAV & COM/ATC 1	3SH1	107/C 1
R	21VU	RADIO NAV & COM/ATC 2	3SH2	107/C14
R	21VU	NAVIGATION/ADS/ADC 2/115 V AC	9FL2	105/E10
R	21VU	RADIO NAV & COM/NAV CTL PNL LT AND SELCAL	3RW	106/D 6
R	22VU	MIN EQT BAY SUPPLY/ADS/ADC 1/115 V AC	9FL1	208/B19
R	132VU	LIGHTING/INTEGRAL LTC/B & OVHD & PED	3LF	322/N77
R	132VU	LIGHTING/INT LT/ANN LT/DIM	197LT	324/L84

PANEL	SERVICE	IDENT.	LOCATION
132VU	LIGHTING/INT LT/ANN LT/DIM	198LT	324/L83
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	149LP	324/L82
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	2LP	324/L81
132VU	LIGHTING/INT LT/ANN LT/TEST/MAN	1LP	324/L80

WARNING : SETTING TO FLIGHT CONFIGURATION CAN BE DANGEROUS FOR GROUND PERSONNEL AND FOR THE AIRCRAFT.

(b)Put the aircraft to flight configuration (Ref. 32-00-00, P. Block 501).

(c)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/DME 1	4SD1	107/C 4
21VU	RADIO NAV & COM/DME 2	4SD2	107/C11
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 FLT/GND	119GB	332/U52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 1 RELAYS & RETRACT CTL	2GB	332/U51
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 FLT/GND	1GB	331/V52
133VU	HYDRAULIC/L/G PROX DET & RELAYS SYS 2 GEAR DOWN & OVHD PNL/POS IND	83GB	331/V51

(d)Test for Enhanced Surveillance:

NOTE : Do the test for system 1. Then, do the test for system 2.

**ON A/C ALL

Post SB 34-2190 For A/C ALL

ACTION	RESULT
1. Set test set (or bench) for the Selected Vertical Intention BDS 4.0 test:	Test set must show:
- Barometric pressure setting	- 1013 hPa.
- FCU selected altitude	- 10,000 ft.
2. Set test set (or bench) for the Track and Turn Report BDS 5.0 test:	Test set must show:
- Roll angle	- X degrees (X is a number that

ACTION	RESULT
	shows approximately the roll of the aircraft).

NOTE : It is not necessary to do a check of other parameters (True Airspeed, Ground speed, True track angle, Track angle rate) from BDS 5.0 as sources are already validated.

3. On 13VU, on FCU (303CA):
   - Turn the altitude selector knob until an altitude of 10,000 ft shows on the ALT SEL display window.

4. On panels 3VU and 5VU, on CAPT (F/O) main altimeter:
   - select Barometric Pressure setting 1013 hPa using pressure selector knob.

5. Set test set (or bench) for the Heading and Speed Report BDS 6.0 test:	Test set must show:
- Magnetic heading	- magnetic heading of aircraft.

NOTE : It is not necessary to do a check of other parameters (barometric altitude rate, inertial vertical velocity, indicated airspeed, Mach number) from BDS 6.0 as sources are already validated.

**ON A/C ALL

Post SB 34-2190 For A/C ALL

6. On panel 21VU close circuit breakers:
   - RADIO NAV & COM/DME 1 (4SD1), location C4
   - RADIO NAV & COM/DME 2 (4SD2), location C11.

7. On panel 133VU close circuit breakers:
   - HYDRAULIC/L/G PROX DET & RELAYS SYS 1/FLT/GND (119GB), location U52
   - HYDRAULIC/L/G PROX DET & RELAYS SYS 1/RELAYS & RETRACT CTL

ACTION	RESULT
(2GB), location U51 - HYDRAULIC/L/G PROX DET & RELAYS SYS 2/FLT/GND (1GB), location V52 - HYDRAULIC/L/G PROX DET & RELAYS SYS 2/GEAR DOWN & OVHD PNL/POS IND (83GB), location V51.	

**ON A/C ALL

(5) Close-Up
(a) Disconnect the antenna from the Mode S/ATCRB System Test Set.
(b) On center pedestal, on ATC control unit 4SH:
- turn rotary selector TEST/STBY/ALT OFF/ALT ON/TA/TA/RA to STBY position.

(c) De-energize the aircraft electrical network and disconnect electrical ground power unit (Ref. 24-41-00, P. Block 301).
(d) Remove Mode S/ATCRB system test set.
(e) Make certain that the working area is clean and clear of tools and miscellaneous items of equipment.

WARNING : CLEANING AGENT (MAT. NO. 11-026) IS DANGEROUS. AVOID INHALING FUMES. USE IN WELL VENTILATED AREA ONLY. IT IS HIGHLY FLAMMABLE AND A SKIN IRRITANT. WEAR PROTECTIVE GLOVES OR USE A BARRIER CREAM. WASH IMMEDIATELY WITH CLEAN WATER, IF SKIN IS SPLASHED WITH SOLVENT.

1. Equipment and Materials

	ITEM	DESIGNATION	
	A. Material No. 05-013	Special Materials (Ref. 20-31-00)	M
R	B. Material No. 09-008E	Sealants (Ref. 20-31-00)	M
	C. Material No. 09-019	Sealants (Ref. 20-31-00)	M
	D. Material No. 11-026	Cleaning Agents (Ref. 20-31-00)	M
	E. Material No. 16-003	Structure Paints (Ref. 20-31-00)	M
	F.	Blanking Cap	
	Referenced Procedure		
	- 20-28-11, P. Block 1	Electrical Bonding - General	D
	- 34-52-00, P. Block 501	ATC	D
	F.	Access Platform 7.90 m (26 ft.)	

NOTE : For access to top mounted ATC antennas use access platform.

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ATC1	3SH1	C 1
21VU	RADIO NAV & COM/ATC2	3SH2	C14

(Ref. Fig. 401)

B. Removal

NOTE : Removal procedure of ATC1 and ATC2 antennas is identical.

WARNING : CLEANING AGENT (MAT. NO. 11-026) IS DANGEROUS.

(1)Remove screws (2).

(2)Separate antenna (3) from fuselage enough to disconnect connector (1).

(3)Remove antenna (3).

(4)Fit blanking cap to connector (1).

(5)Remove old sealant from fuselage, using cleaning agent (Mat. No. 11-026).

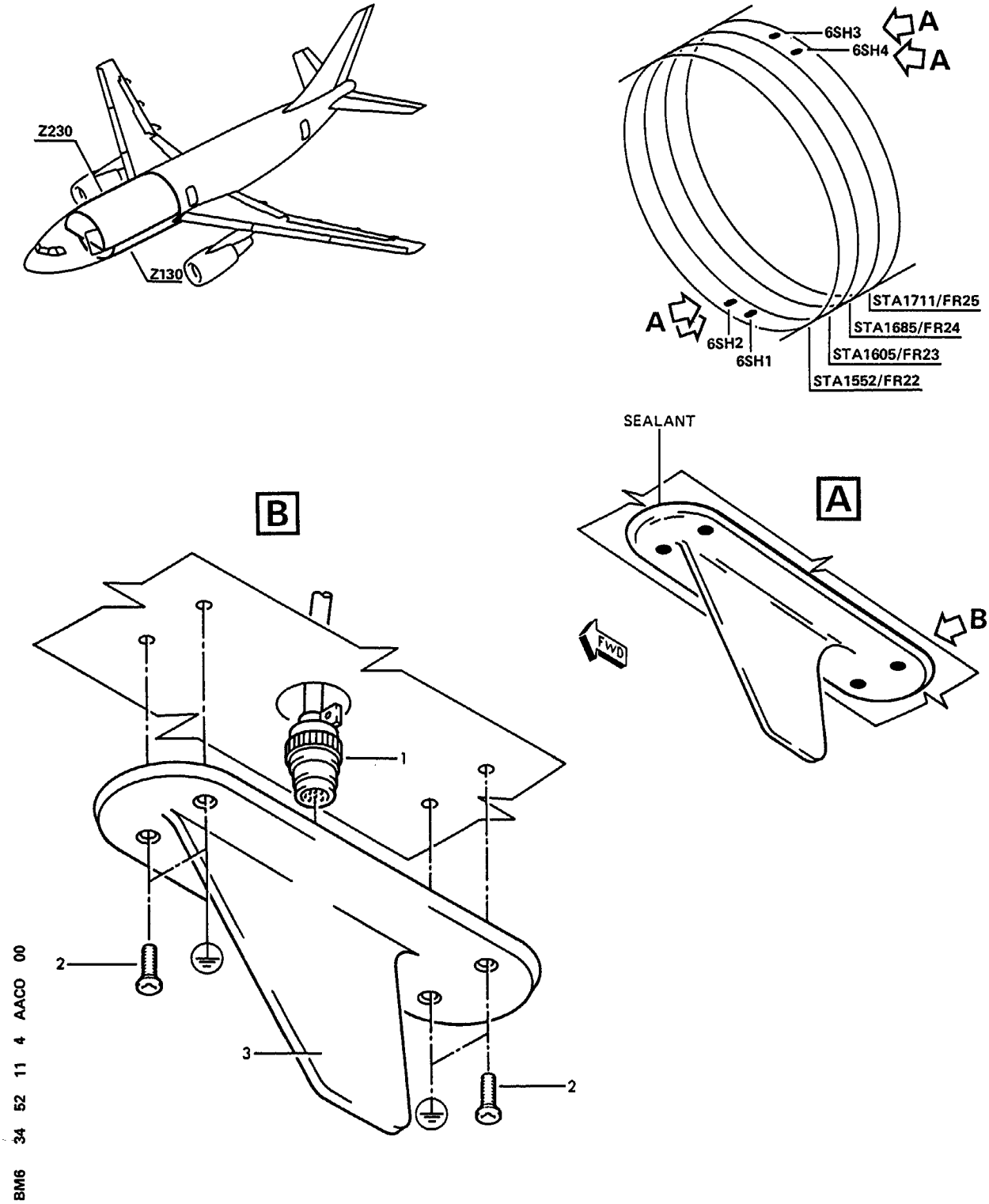
C. Installation

NOTE : Installation procedure of ATC1 and ATC2 antennas is identical.

(1)Apply separating agent (Mat. No. 05-013) to mounting surfaces of antenna and fuselage.

(2)Apply sealant (Mat. No. 09-019) to mounting surfaces of antenna and fuselage.

NOTE : Keep ground connections clean of sealant.



ATC Antenna
Figure 401

R

(3)Remove blanking cap from connector (1) and connect to antennna (3).
(4)Position antenna (3) and install on fuselage, using screws (2).
(5)Measure the bonding contact resistance between the antenna (3) and the fuselage structure (Ref. Task 20-28-11, P. Block 1).

NOTE : Make sure that the bonding contact resistance is not more than 5 milliohms.

(6)Remove excess sealant.
R (7)Make a sealing bead with sealant (Mat. No. 09-008E) around the antenna (3).
R (8)Apply sealant (Mat. No. 09-008E) on the head of the screws (2).
(9)Make the contour of the sealant on the screws (2) and around the antenna smooth.
(10)After sealant has cured, apply structure paint (Mat. No. 16-003) to the sealing bead around the antenna.
NOTE : It is not mandatory to paint the sealant around the base of the antenna and on the head of the screws.

(11)Remove safety clips and tags and close circuit breakers 3SH1 and 3SH2.

D. Test
(1)Carry out ATC operational test (Ref. 34-52-00, P. Block 501).

E. Close-Up
(1)Make sure that working area is clean and clear of tools and miscellaneous items of equipment.

R

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-52-00, P. Block 501	ATC System

(Ref. Fig. 401)

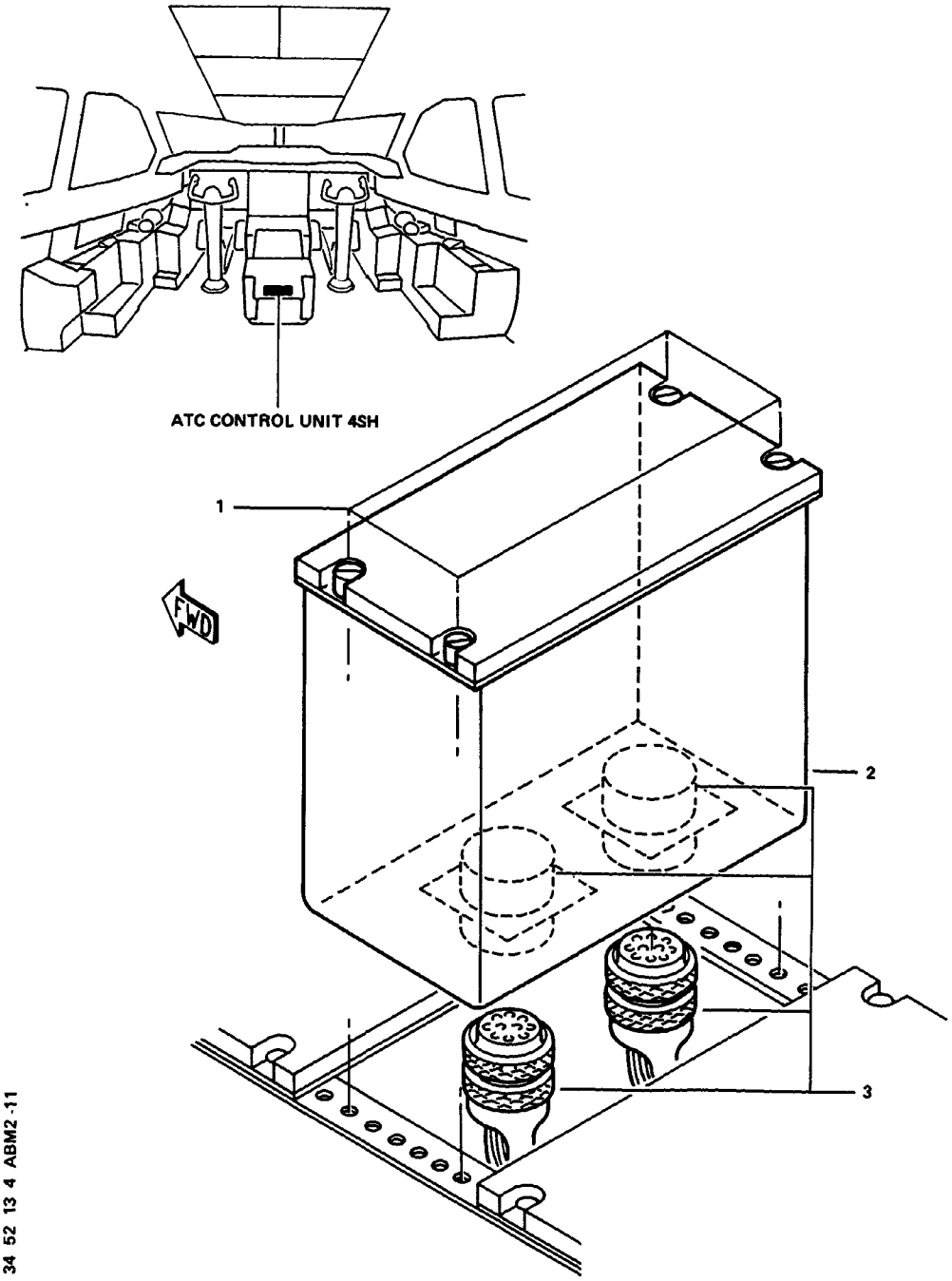
2. Procedure

A. Job Set-Up
Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/ATC1	3SH1	107/C 1
21VU	RADIO-NAV & COM/ATC2	3SH2	107/C14
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77

B. Removal
(1)Unlock the four quick release fasteners (1).
(2)Withdraw ATC control unit (2) from housing so as to disconnect electrical connectors (3).
(3)Disconnect electrical connectors (3) and remove ATC control unit (2).
(4)Blank electrical connectors (3).

C. Installation
(1)Clean and inspect ATC control unit interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (3) and make certain that connector ends are in correct condition.
(3)Position ATC control unit (2) and connect electrical connectors (3) to their corresponding receptacles on control unit.
(4)Install ATC control unit (2) in housing.
(5)Lock the four quick release fasteners.
(6)Remove safety clips and tags and close circuit breakers 3SH1, 3SH2 and 3LF.



BM5 34 52 13 4 ABM2·11

ATC Control Unit
Figure 401

D. Test
Carry out operational test of ATC system (Ref. 34-52-00, P. Block 501).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Blanking Plugs/Caps
B.	Circuit Breaker Safety Clips
Referenced Procedure - 34-52-00, P. Block 501	ATC

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breaker :
(a)For ATC transponder 1SH1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM-ATC1	3SH1	107/C01

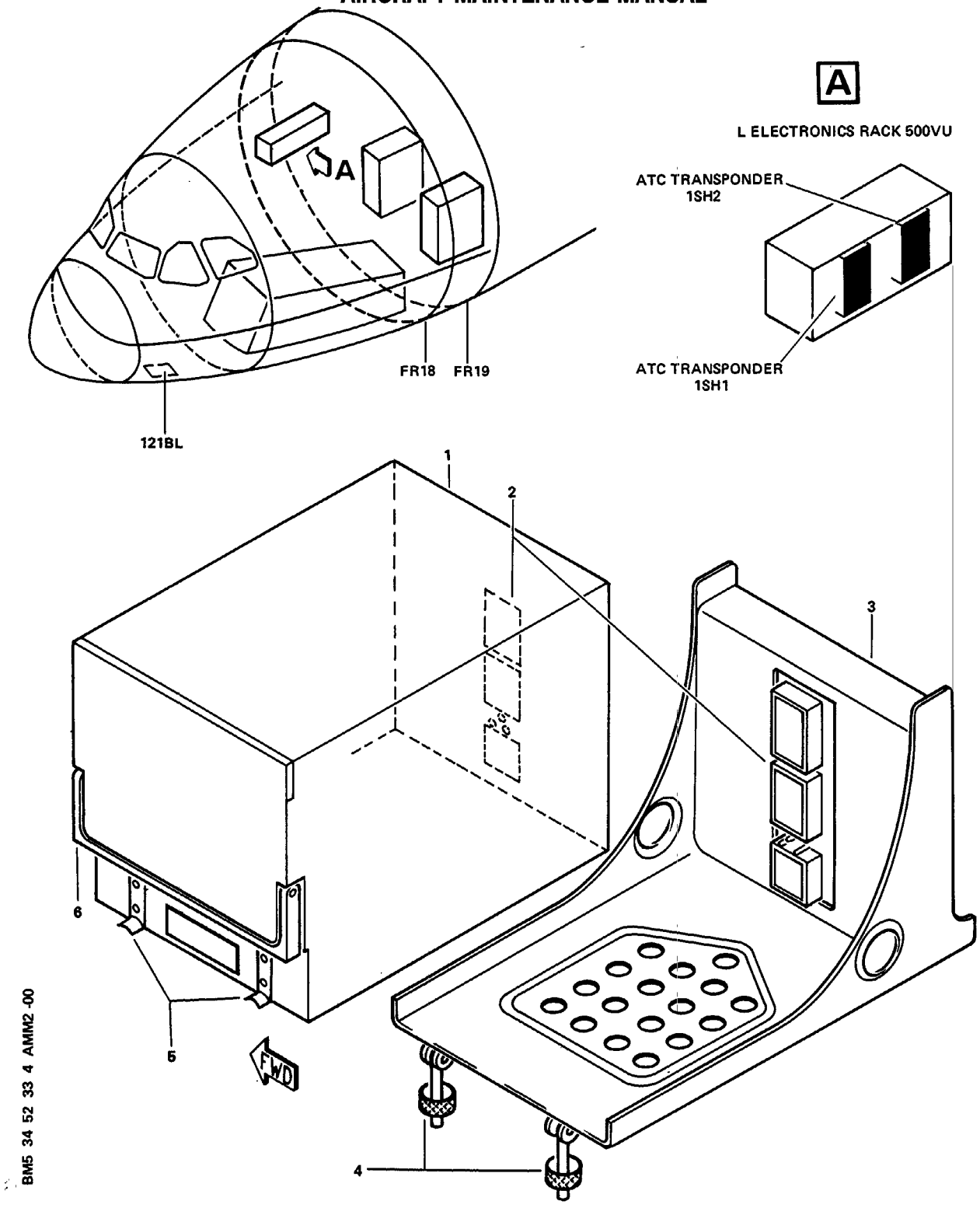
R
(b)For ATC transponder 1SH2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM-ATC2	3SH2	107/C14

(2)Open access door 121Bl to gain access to avionics compartment.

B. Removal
(1)Unscrew knurled nuts on tenons (4). Tilt tenons (4) downwards to disengage them from studs (5).
(2)Move up handle (6) and withdraw ATC transponder (1) from rack (3).
(3)Blank electrical connectors (2).
(4)Remove ATC transponder (1).

C. Installation
(1)Clean and inspect ATC transponder interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (2). Make certain that connectors are clean and in correct condition.
(3)Install ATC transponder (1) in rack (3).
(4)Tilt tenons (4) upwards and lift knurled nuts into position on studs (5). Tighten.
(5)Move down handle (6).
(6)Remove safety clip and tag and close circuit breaker :
(a)For ATC transponder 1SH1 : 3SH1.
(b)For ATC transponder 1SH2 : 3SH2.



ATC Transponder
Figure 401

R

D. Test
Carry out operational test of ATC transponder (Ref. 34-52-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.

ADF - DESCRIPTION AND OPERATION

1. General

The ADF system is a medium range radio navigation aid using the 190-1750 kHz frequency band. The frequency band allows the receiving of nondirectional beacons (NDBs) as well as broadcast AM stations. With the aid of a special antenna the ADF system evaluates the relative bearing to the respective ground station. Further the ADF provides an aural identification of the station.

2. Component Location

R **ON A/C 101-200,

(Ref. Fig. 001)

R **ON A/C 001-100,

(Ref. Fig. 002)
(Ref. Fig. 003)

R **ON A/C 101-200,

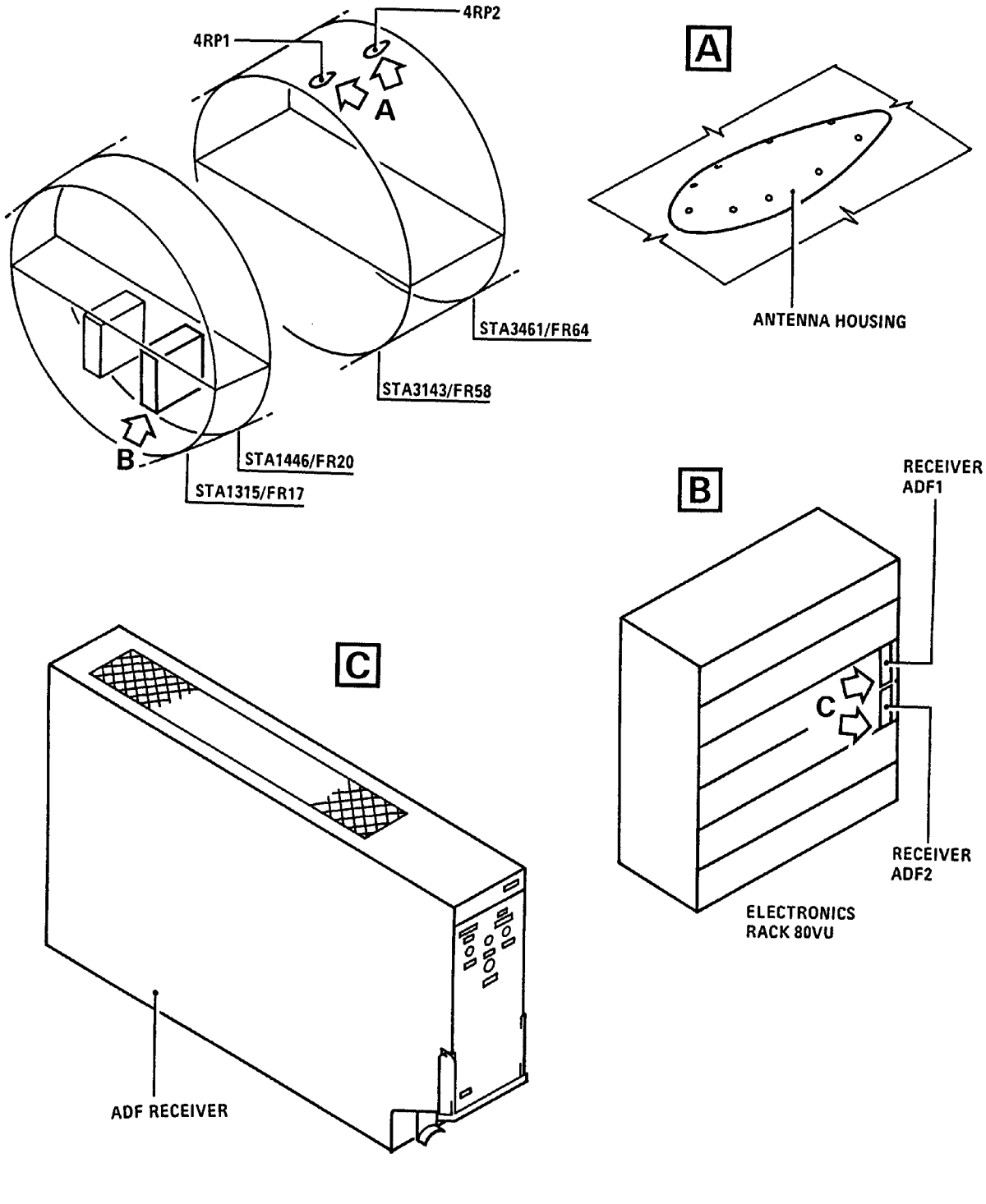
(Ref. Fig. 004)

R **ON A/C ALL

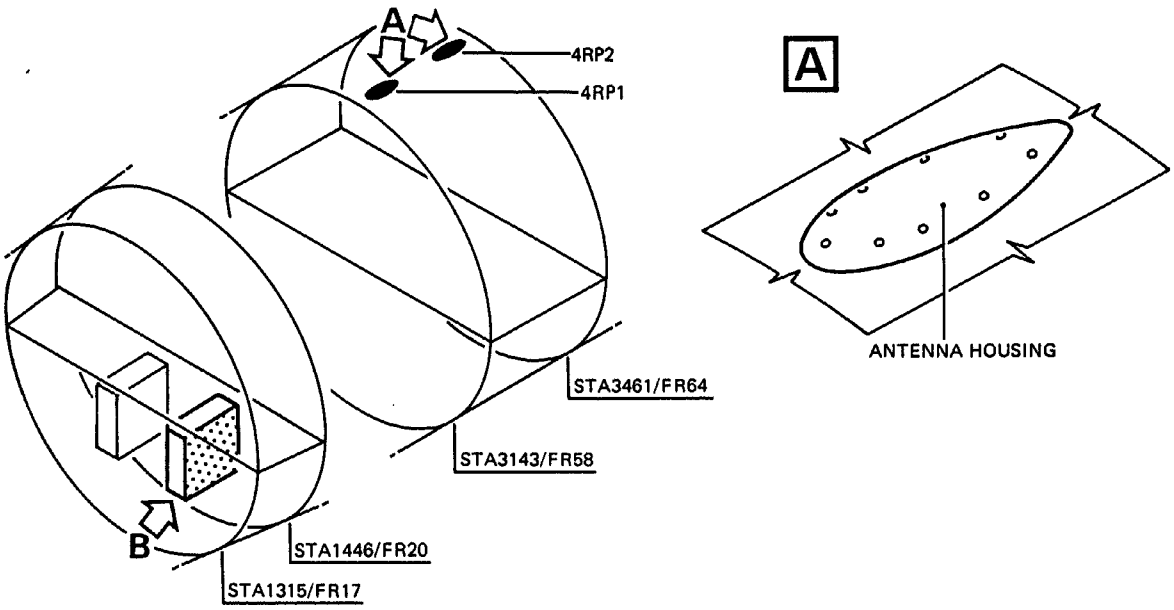
FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
	ADF SYSTEM:				
1RP1	RECEIVER ADF 1	83VU	121		34-53-31
1RP2	RECEIVER ADF 2	84VU	121		34-53-31
3RP1	CONTROL UNIT ADF 1	11VU	211		34-53-13
3RP2	CONTROL UNIT ADF 2	11VU	212		34-53-13
4RP1	ANTENNA ADF LOOP AND SENSE 1		250		34-53-11
4RP2	ANTENNA ADF LOOP AND SENSE 2		250		34-53-11
11RP1	TEST BUTTON ADF 1	470VU	212		
11RP2	TEST BUTTON ADF 2	470VU	212		
16RP1	MOUNT RECEIVER ADF 1	83VU	121		
16RP2	MOUNT RECEIVER ADF 2	84VU	121		
	ASSOCIATED SYSTEMS:				
24FN1	ADF RMI CAPT	3VU	211		
24FN2	ADF RMI F/O	5VU	212		
28FN1	EFIS SGU1	85VU	121		
28FN2	EFIS SGU2	86VU	121		
28FN3	EFIS SGU3	85VU	121		
36FN1	EFIS ND CAPT	3VU	211		
36FN2	EFIS ND F/O	5VU	212		
44GB	AIR/GROUND RELAY	104VU	121		
143GB	AIR/GROUND RELAY	83VU	121		

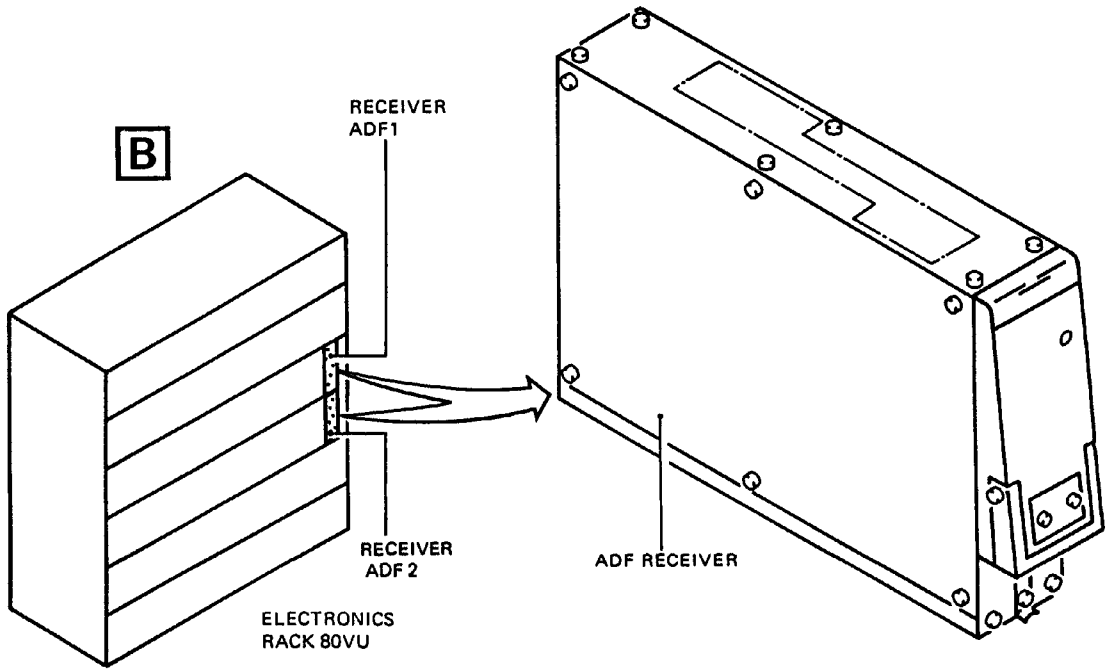
NOTE : For system components which are mentioned but not described in detail, please refer to:

Audio Integrating Sys.	(Ref. 23-50-00)
Annunciator Lights	(Ref. 33-14-00 and 33-16-00)
RMIs	(Ref. 34-29-00)
EFIS, ND	(Ref. 34-70-00 and 34-75-00)



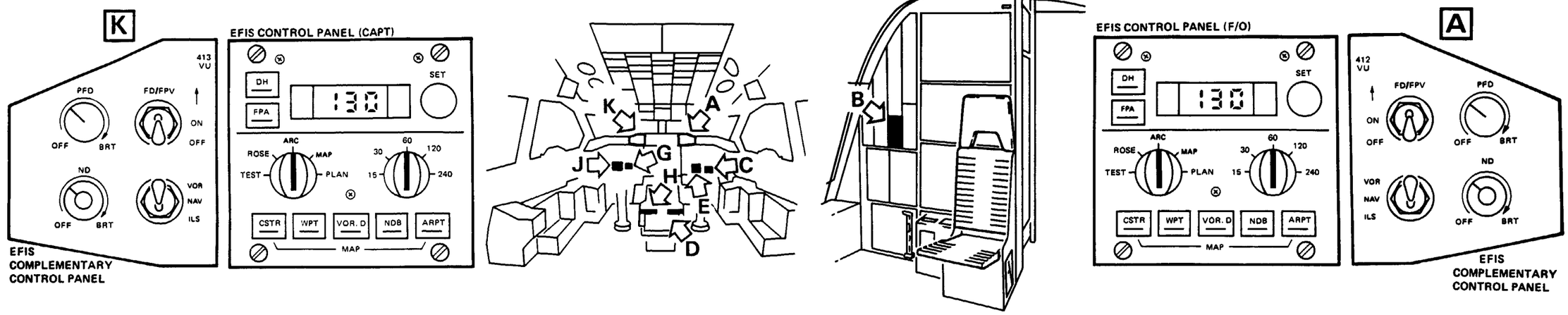
ADF - Component Location - Electronics Compartment
Figure 001

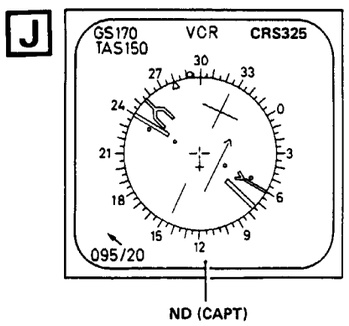


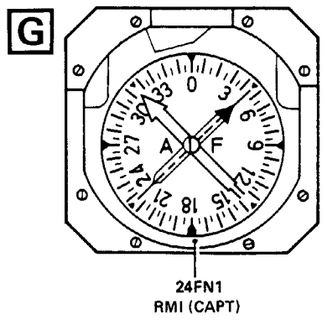


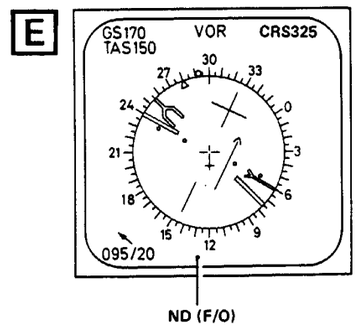
BM6 34 53 00 0 AACO 00

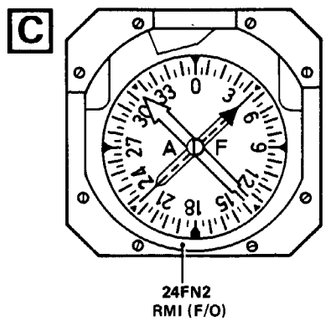
ADF - Component Location - Electronics Compartment
Figure 002

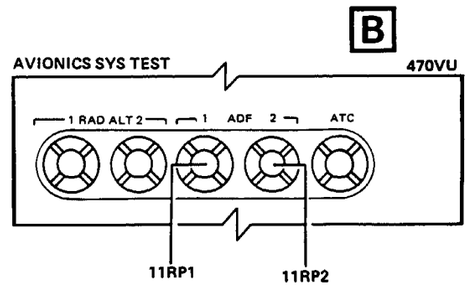


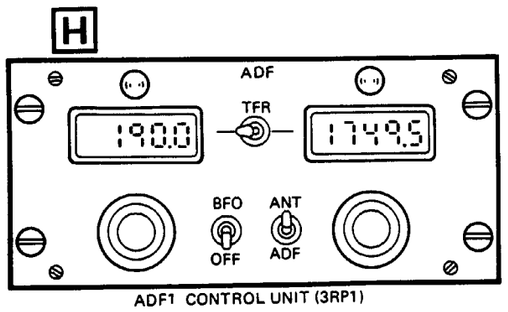


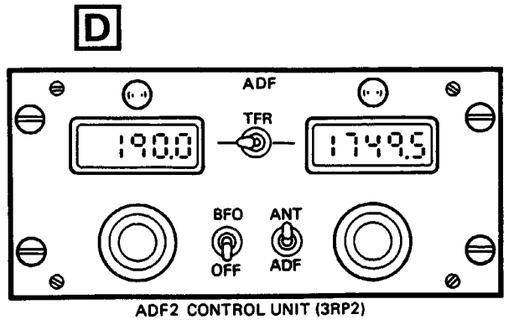






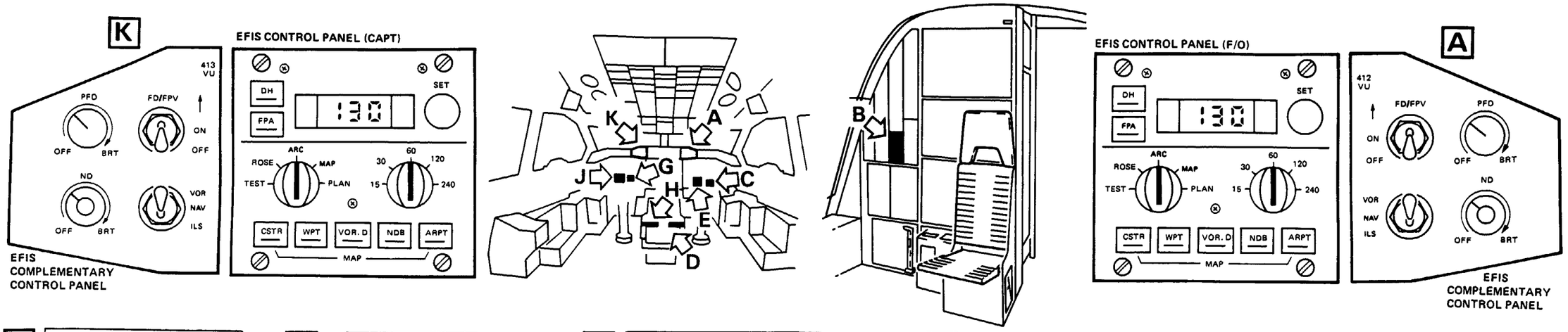


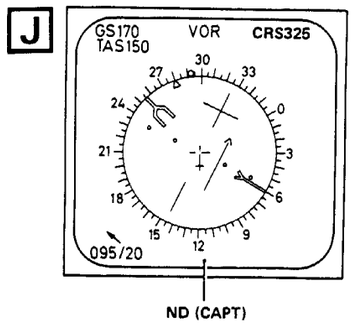


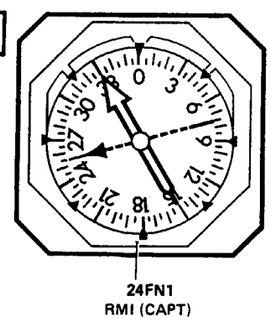


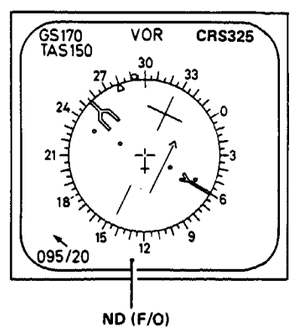
BM6 34 53 00 0 ACE0 01

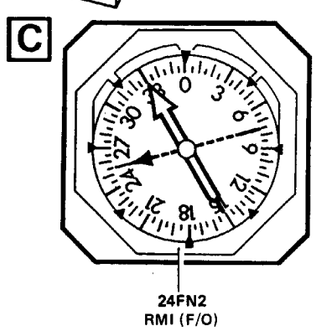
ADF - Component Location - Flight Compartment
Figure 003

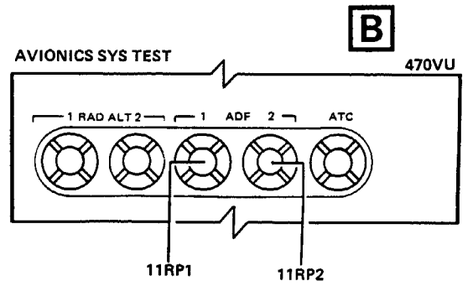


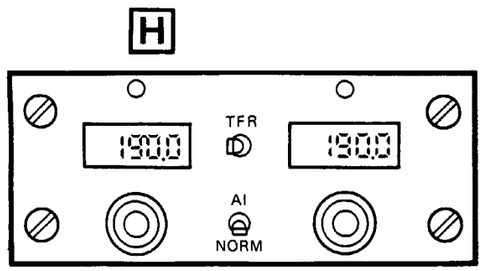


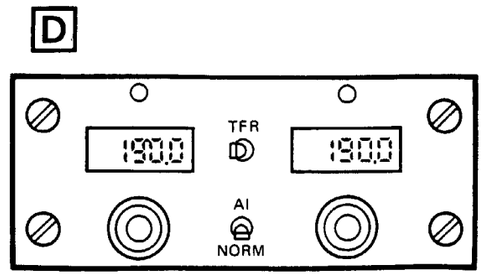












BM6 34 53 00 0 ACMO 00

ADF - Component Location - Flight Compartment
Figure 004

3. System Description

A. Principle (Ref. Fig. 005)
The principle of ADF navigation is the onboard direction finding to a selected NDB ground station or another ground station including broadcast stations.
The frequency range is defined from 190 kHz to 1750 kHz.
Two combined loop-sense antennas are fixed mounted on the aircraft.
Each loop-sense antenna consists of two loop antennas and a sense antenna.
The received signal strength is relative to the position of the antenna and the aircraft with respect to the transmitting ground station.The respective two loop antennas are physically positioned 90° apart in such a way that the signal strength received in one is proportional to sine and in the other to the cosine function of the relative angle between aircraft heading and direction to the ground transmitter. The sign of the sine and cosine value is represented by the phase of the signal. To determine the correct bearing angle the sine and cosine angle must be combined with a signal which is not affected by relative bearing. This signal is obtained from the omnidirectional sense antenna.
The combined loop and sense antenna deliver the sine and cosine signals and the sense signal to the ADF receiver. Using this information the receiver calculates relative bearing. This information is displayed on RMIs and NDs. An additional value and/or morse coded audio is provided to identify the selected ground stations.

R **ON A/C 001-100,

(Ref. Fig. 006)

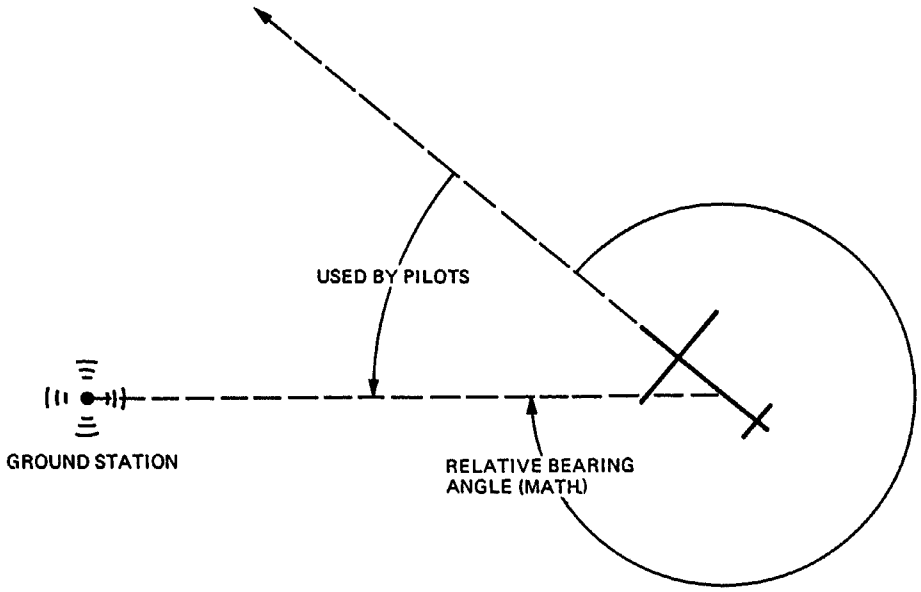
R **ON A/C 101-200,

(Ref. Fig. 007)

R **ON A/C ALL

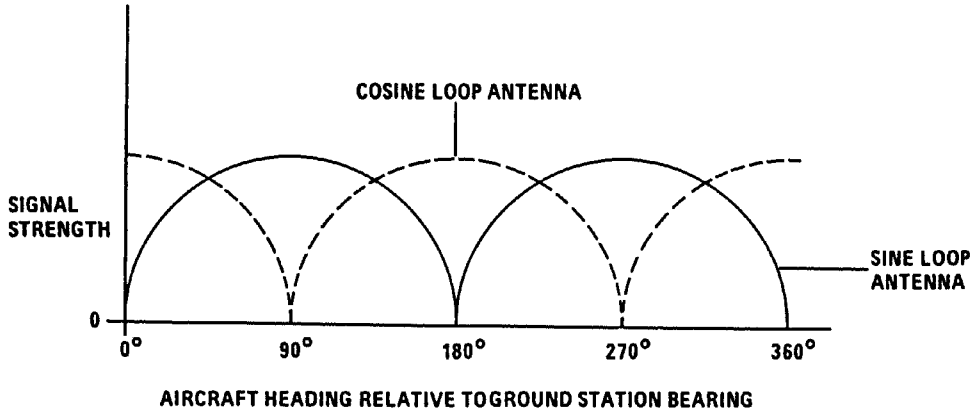
B. System Architecture
The aircraft is equipped with two ADF systems.
In the system each ADF receiver is connected to:
- the combined loop and sense antenna
- the Control Unit
- the RMIs
- the Audio Integrated System
- the AVIONICS SYS TEST panel
- the EFIS SGUs.

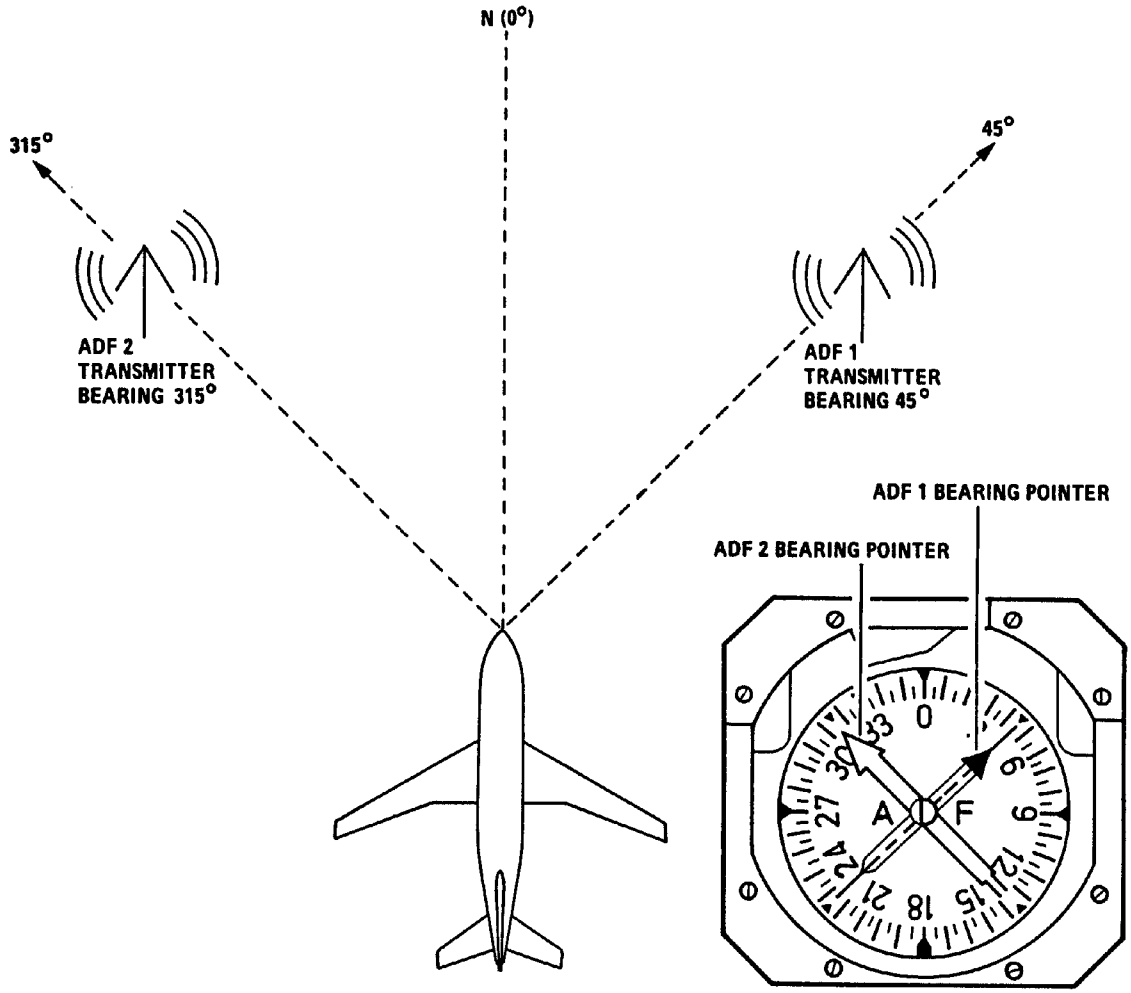
The antennas contain the loop and sense elements and 3 buffer amplifiers, the loop element includes a testing coil. An ADF test signal can be fed into the antenna for test purpose.The test signal is applied to the testing coil, which generates an electromagnetic field. The transmission lines from the antenna to the receiver have an impedance of 78 Ohm.
The control unit provides the frequency command for the receiver, and



BM6 34 53 00 0 AEA0 00

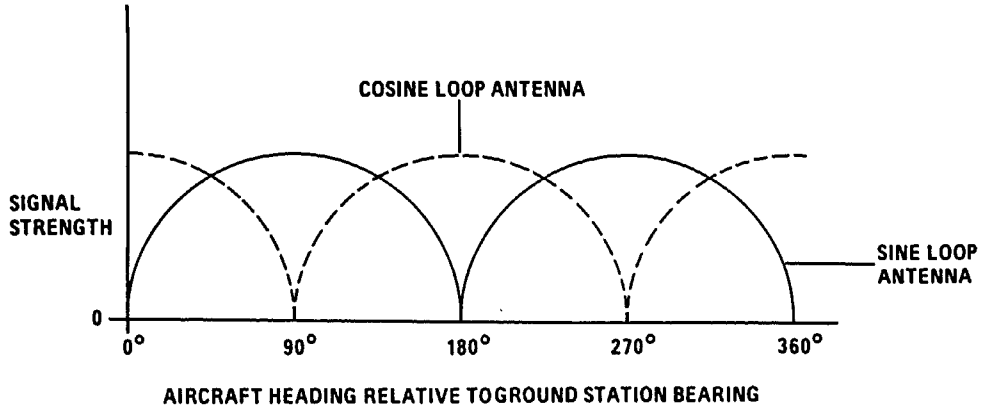
ADF - System Principle
Figure 005

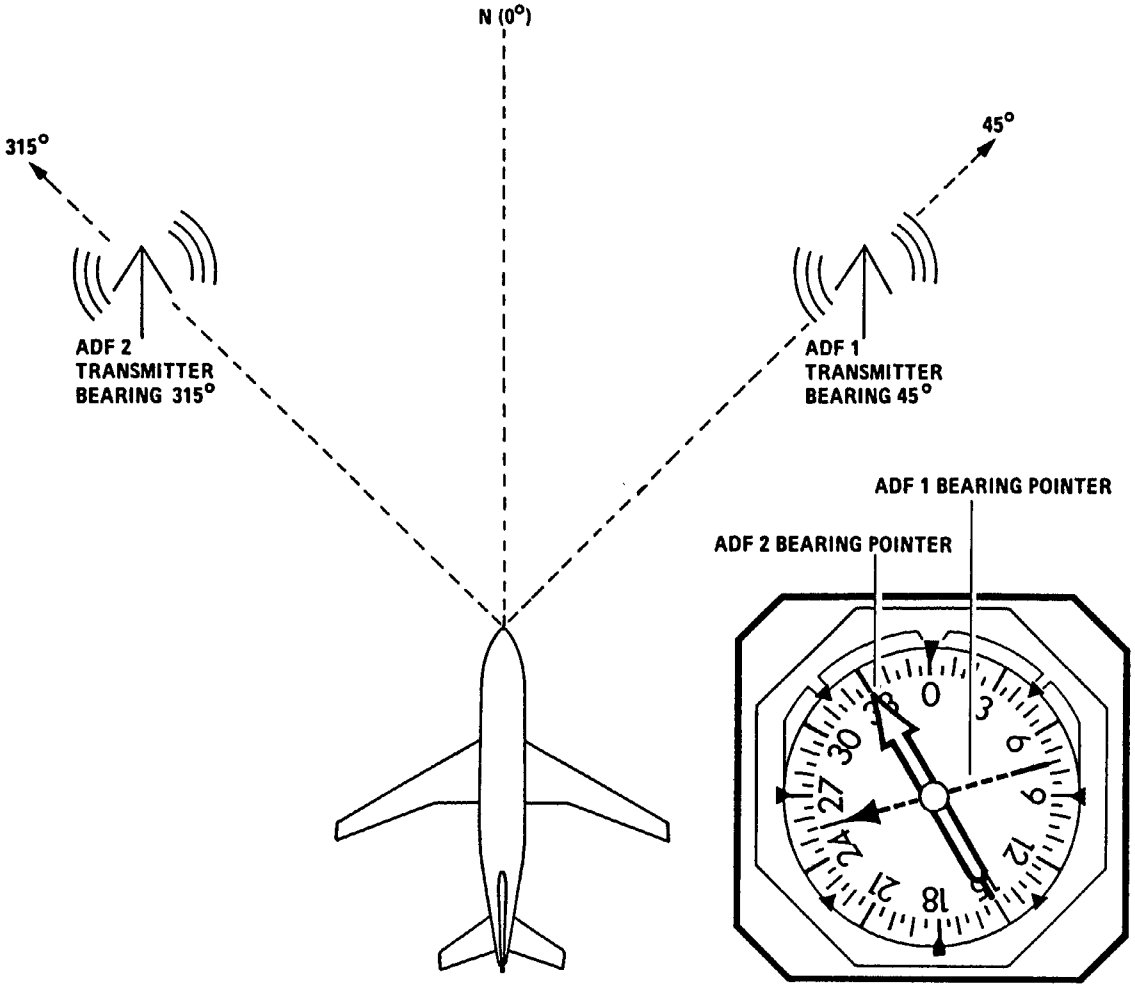




BM6 34 53 00 0 AGAO 00

ADF - Bearing Indication
Figure 006





BM6 34 53 00 0 AGDO 00

ADF - Bearing Indication
Figure 007

the switching of function modes. The receiver data output is connected to the RMIs and the NDs (via EFIS SGUs) to indicate the bearing information.
The receiver audio outputs supply the audio integrated system with the related identification signals or the voice signals from the ground station.
The integral test circuit of the receivers is activated by the related test buttons on the AVIONICS SYS TEST panel (in maintenance panel).

**ON A/C 001-100,

(Ref. Fig. 008)

**ON A/C 101-200,

(Ref. Fig. 009)

R **ON A/C 001-100,

R Post SB 34-2208 For A/C 001-100,

R (Ref. Fig. 010)

R **ON A/C 101-200,

R Post SB 34-2208 For A/C 101-200,

R (Ref. Fig. 011)

**ON A/C ALL

C. Power Supply (Ref. Fig. 012)
The ADF systems are supplied with 115 V AC, 400 Hz.
- The ADF receiver 1 and the control unit 1 are supplied from emergency busbar 401XP via circuit breaker 10RP1.
- The ADF receiver 2 and the control unit 2 are supplied from normal busbar 205XP via circuit breaker 10RP2.
- RMI 1 is supplied from normal busbar 105XP via circuit breaker 46FN 1.
- RMI 2 is supplied from normal busbar 205XP via circuit breaker 46FN 2.
- The loop/sense antenna is supplied with +/-12V DC from receiver.

R **ON A/C ALL

R Post SB 34-2208 For A/C ALL

R
R C. Power Supply (Ref. Fig. 013)

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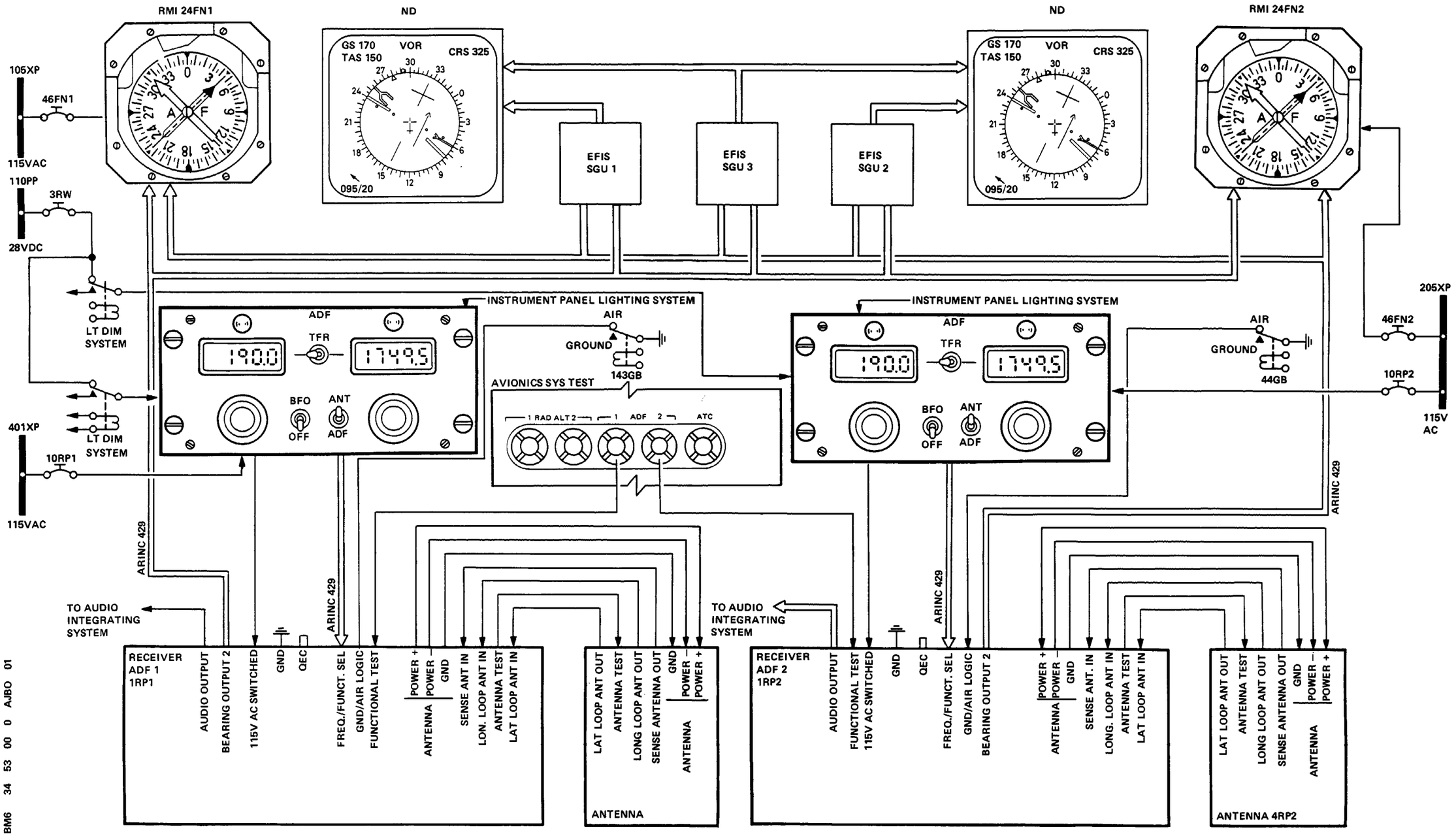
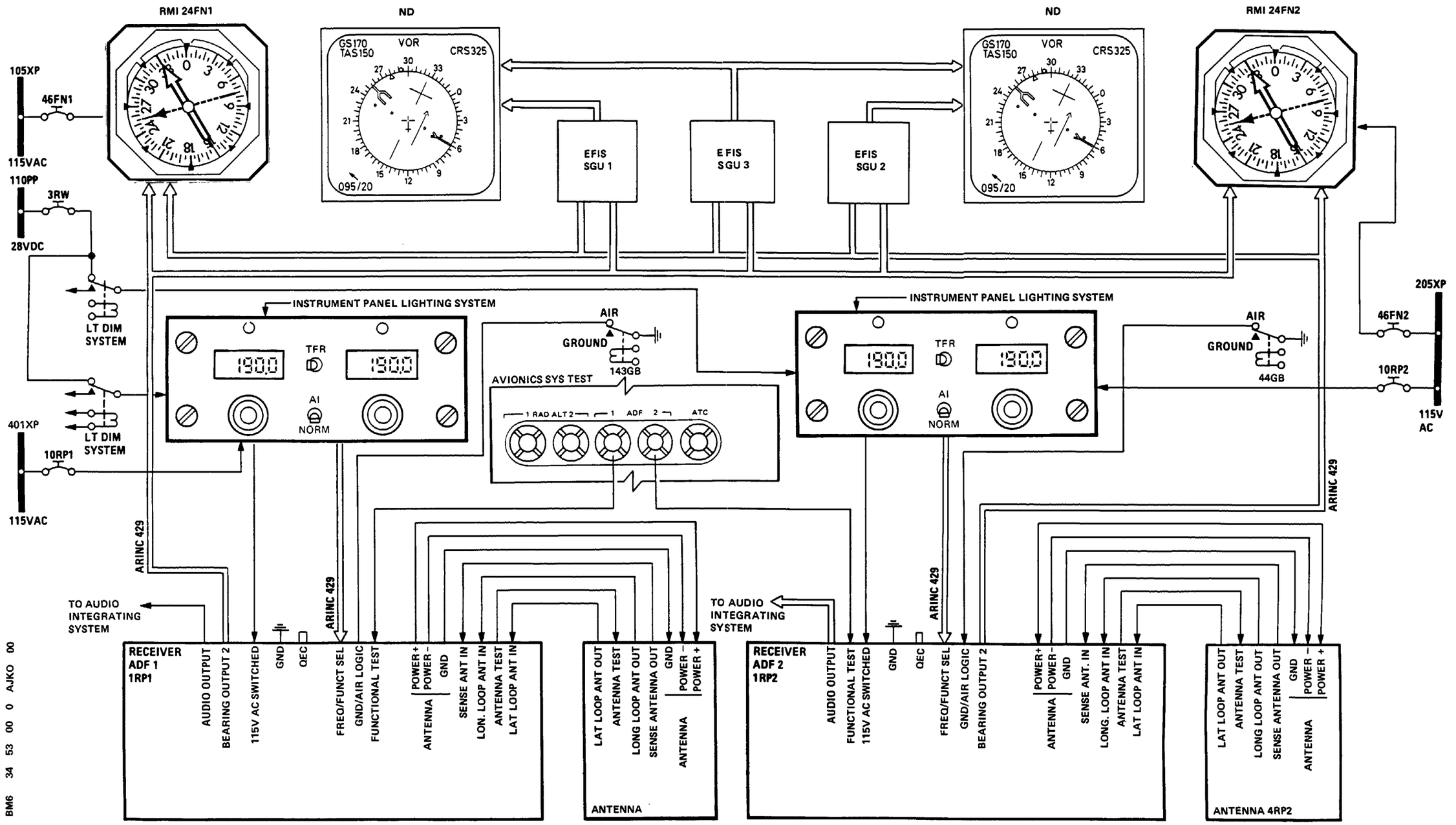
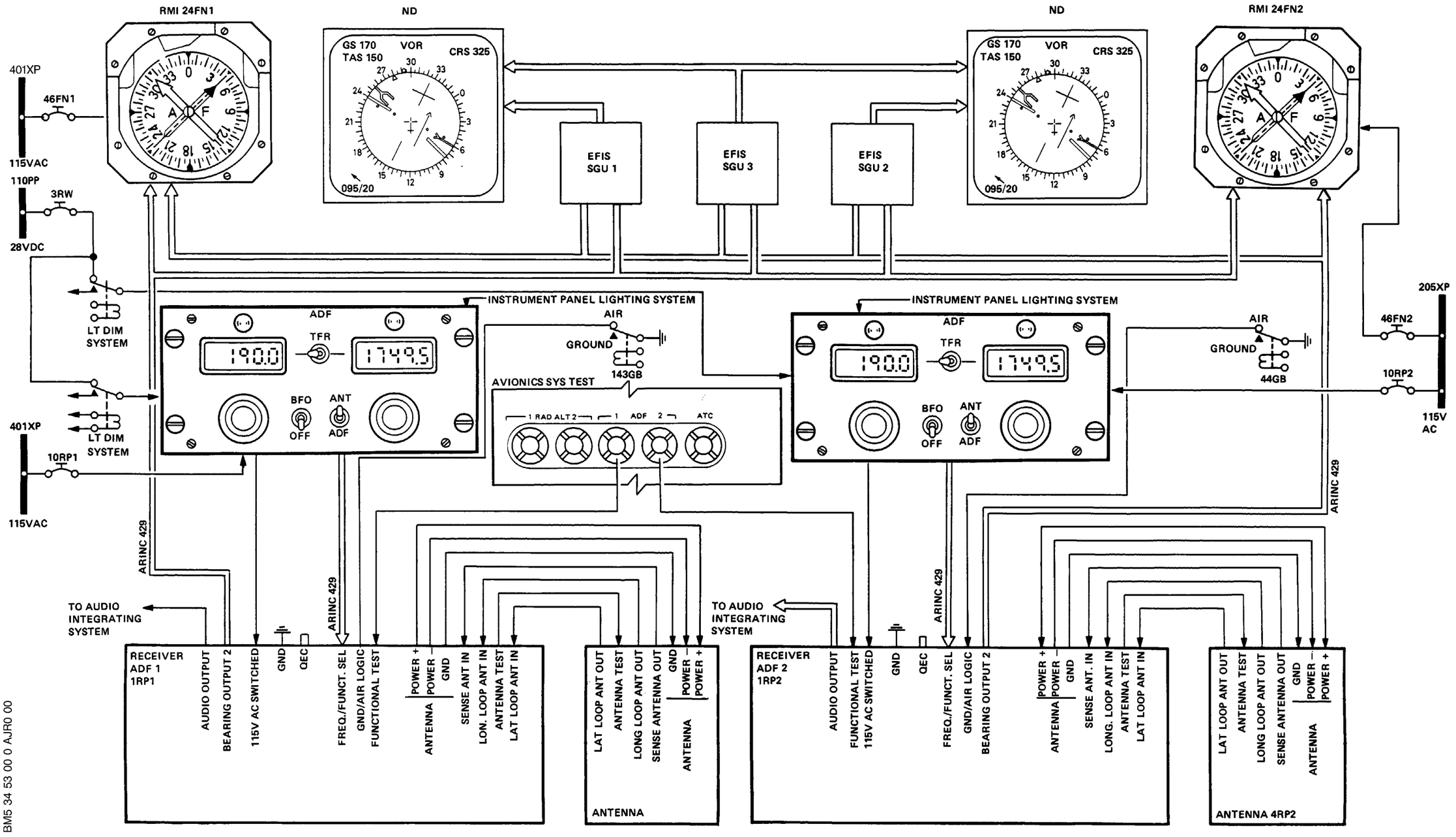


ADF - System Architecture
Figure 008



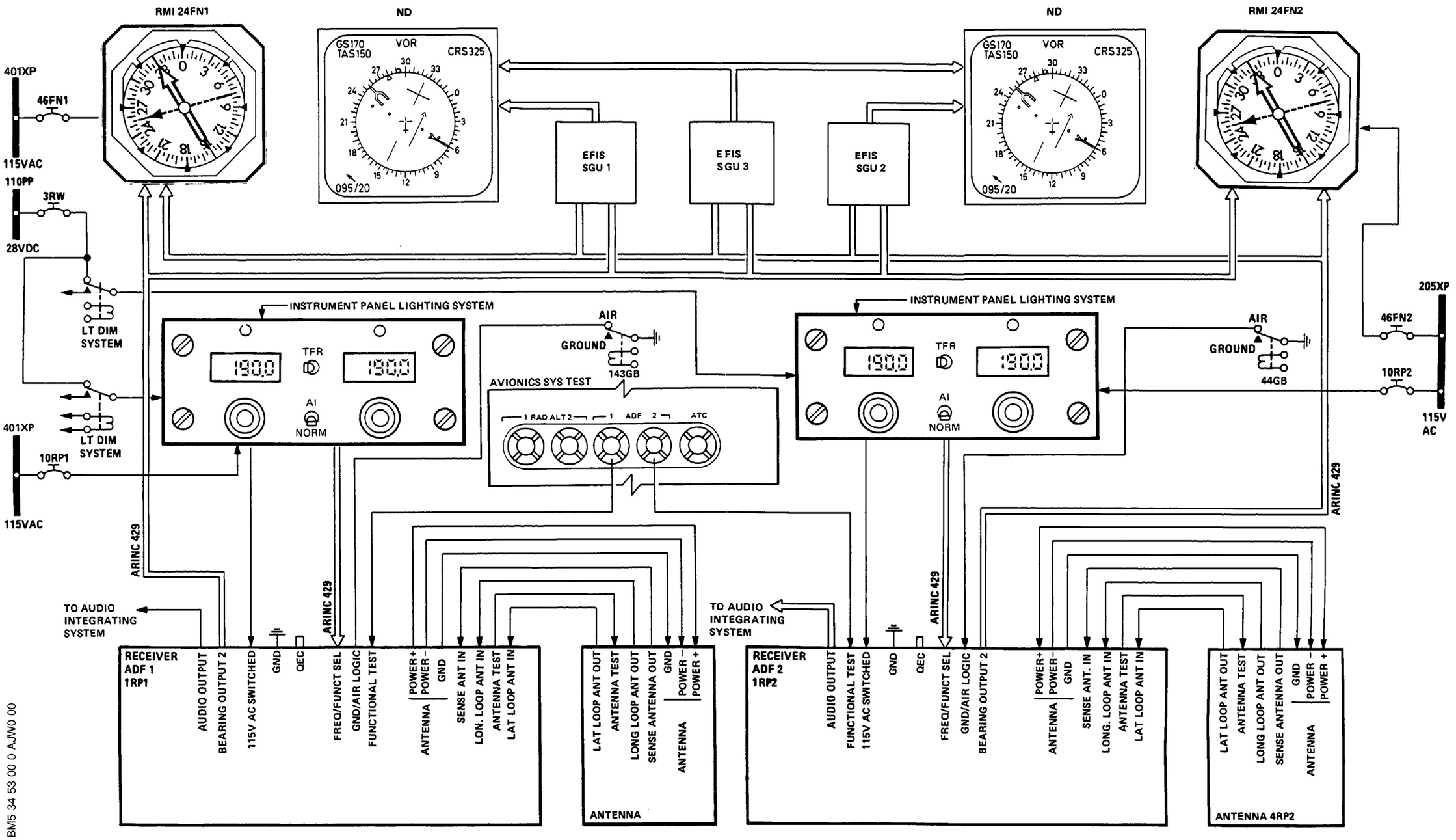
ADF - System Architecture
Figure 009



BM5 34 53 00 0 AJR0 00

ADF - System Architecture
Figure 010

R



ADF - System Architecture
Figure 011

The ADF systems are supplied with 115 V AC, 400 Hz.
- The ADF receiver 1 and the control unit 1 are supplied from emergency busbar 401XP via circuit breaker 10RP1.
- The ADF receiver 2 and the control unit 2 are supplied from normal busbar 205XP via circuit breaker 10RP2.
- RMI 1 is supplied from emergency busbar 401XP via circuit breaker 46FN 1.
- RMI 2 is supplied from normal busbar 205XP via circuit breaker 46FN 2.
- The loop/sense antenna is supplied with +/-12V DC from receiver.

**ON A/C ALL

(Ref. Fig. 012)

**ON A/C ALL

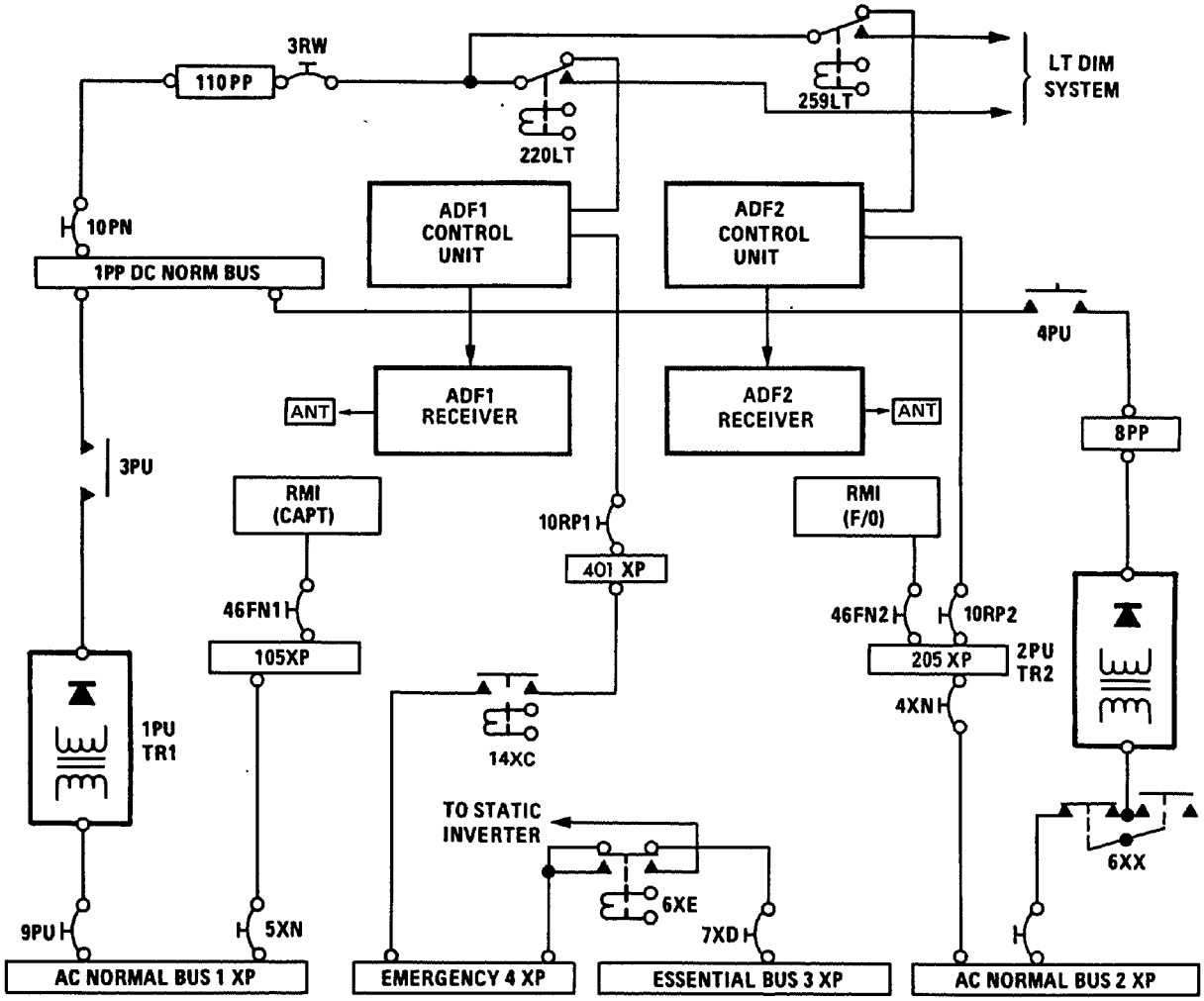
Post SB 34-2208 For A/C ALL

R (Ref. Fig. 013)

**ON A/C 101-200,

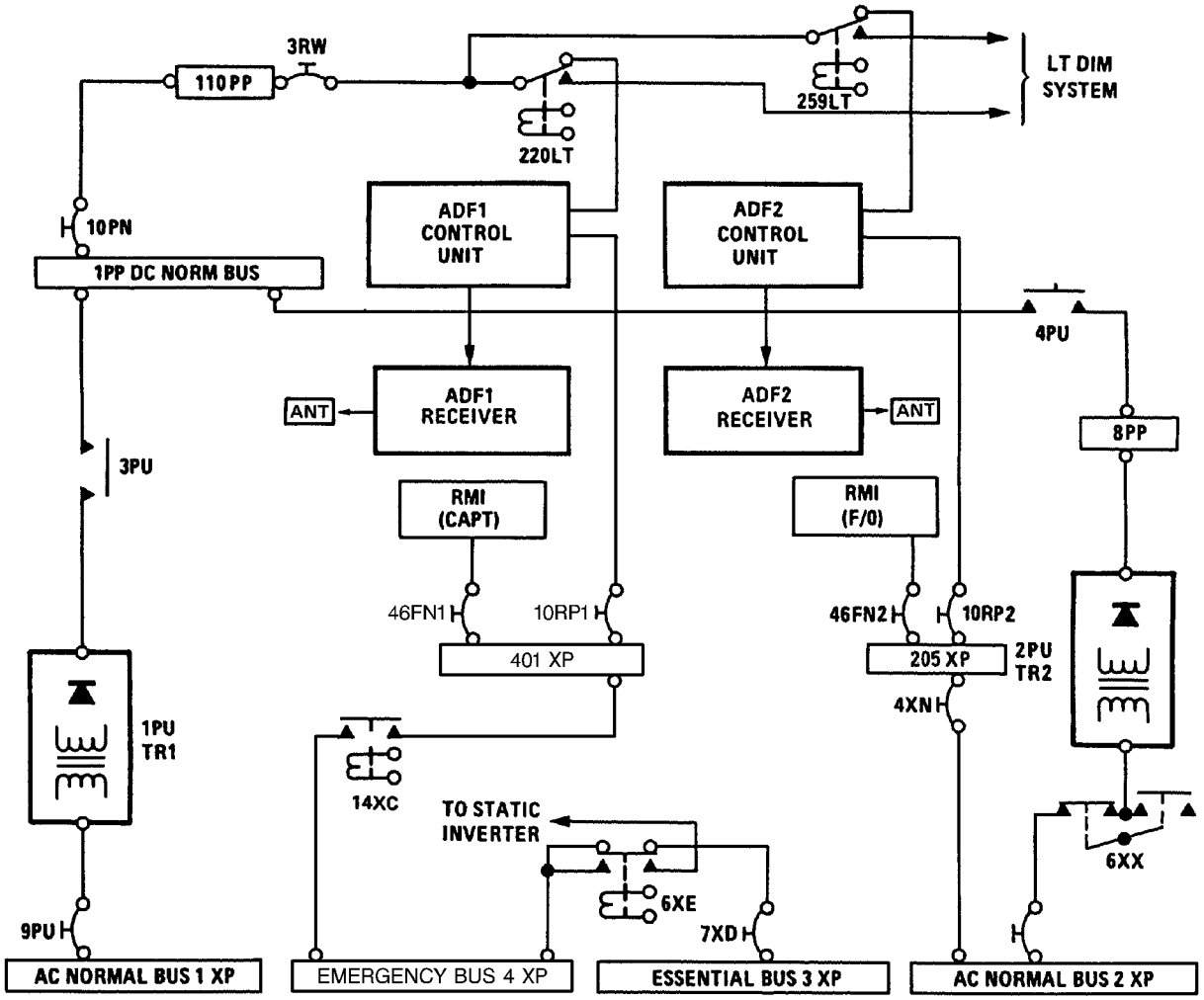
4. Component Description

A. ADF Receiver
(1)Description (Ref. Fig. 014)
The receiver determines the relative bearing to any selected transmitter operating between 190 and 1750 kHz. This bearing data is converted into ARINC 429 format and transmitted through ARINC buses to the RMIs and the EFIS. In addition the AM modulation of the carrier wave is detected and applied to the audio integrating system.
The receiver is housed in an ARINC 2MCU case and consists of an aluminum chassis on which the following assemblies are mounted:
- The tuner which modulates, combines and amplifies the IF signal received from loop and sense antenna. The tuner also includes detector and audio processing circuits.
- The synthesizer which produces fixed and variable frequencies used in the receiver.
- The backplane which provides interface between the rear connector and the other assemblies.
- The input/output assembly for interface with the aircraft circuits.
- The processor which generates the basic clock signals used and converts the analog bearing into digital data for the input/output assembly.
- The preprocessor which generates the 96 Hz reference signal used to modulate the signals from the loop antenna.
- The power supply assembly which converts the 115 V AC aircraft supply into the various voltages used by the internal circuits of the receiver.
- The front panel features:



BM6 34 53 00 0 AKCO 00

ADF - System Power Supply
Figure 012



BM5 34 53 00 0 AKG0 01

R

ADF - System Power Supply
Figure 013

- three self-test indicator LEDs and
- a self-test pushbutton switch

Electrical connections to the aircraft circuits are made through a connector on the rear of the receiver.

**ON A/C 001-100,

4. Component Description

A. ADF Receiver

(1)Description (Ref. Fig. 015)

The receiver determines the relative bearing to any selected transmitter operating between 190 and 1750 kHz. This bearing data is converted into ARINC 429 format and transmitted through ARINC buses to the RMIs and EFIS.

In addition the AM modulation of the carrier wave is detected and applied to the audio integrating system.

The receiver is housed in an ARINC 2MCU case and consists of the following interconnected modules:

- A receiver module combines the sense and loop signals from the antenna and provides data bearing and audio outputs.
- A synthesizer module generates fixed and variable oscillations to tune the receiver.
- A coherent demodulator module detects bearing data from the composite input signal.
- The signal processor module converts the bearing data from the coherent demodulator into a digital ARINC word format which is then transmitted to the RMI and EFIS.
- A power supply module converts the 115 V AC aircraft supply into the various voltages used by the internal circuits of the receiver.
- A BITE module controls functional and automatic self tests in the receiver.

Light emitting diodes (LED) annunciators and a TEST pushbutton switch is provided on the frontpanel.

Electrical connections to the aircraft circuits are made through a connector on the rear of the receiver.

**ON A/C 101-200,

(Ref. Fig. 014)

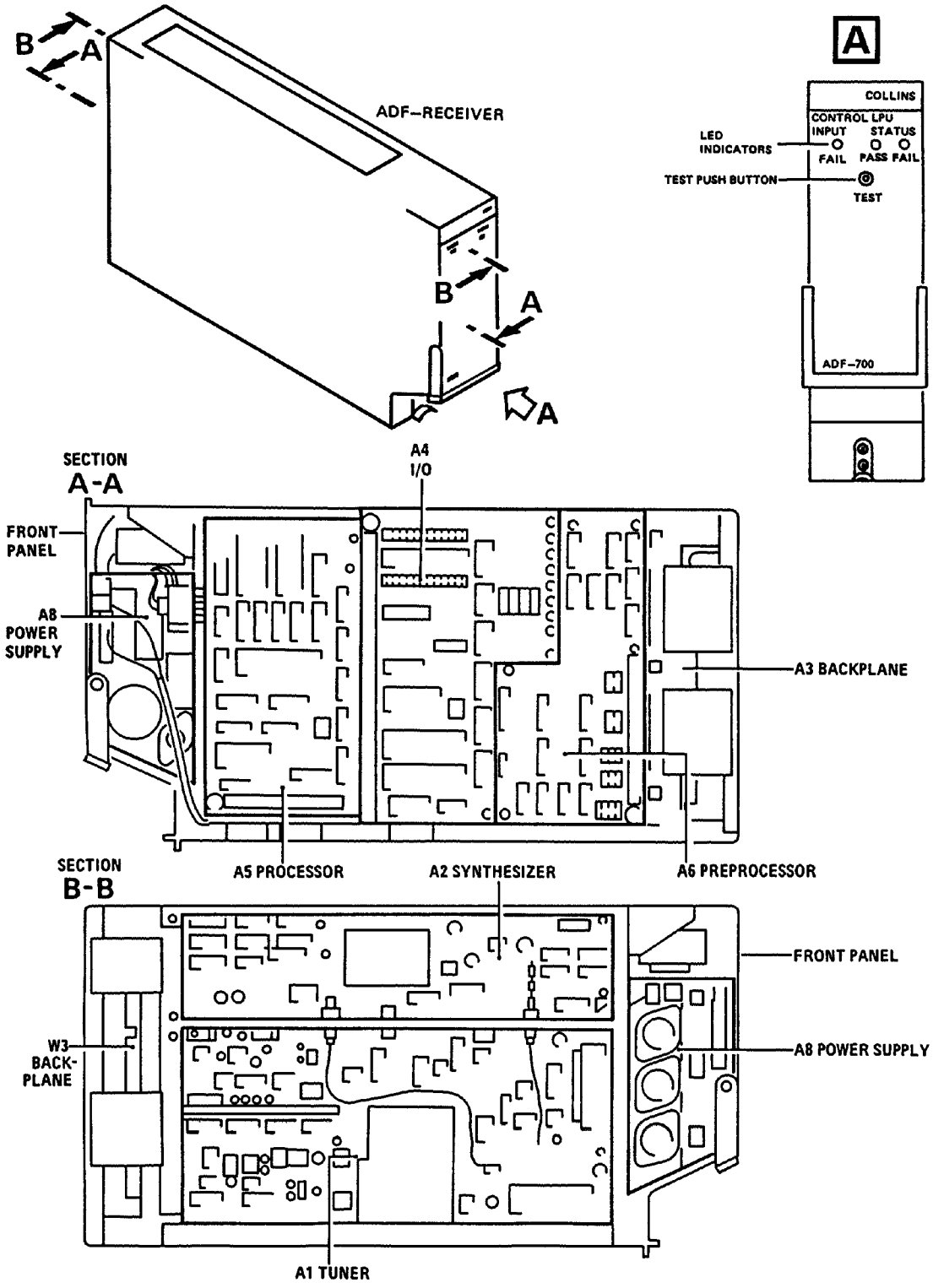
**ON A/C 001-100,

(Ref. Fig. 015)

**ON A/C 101-200,

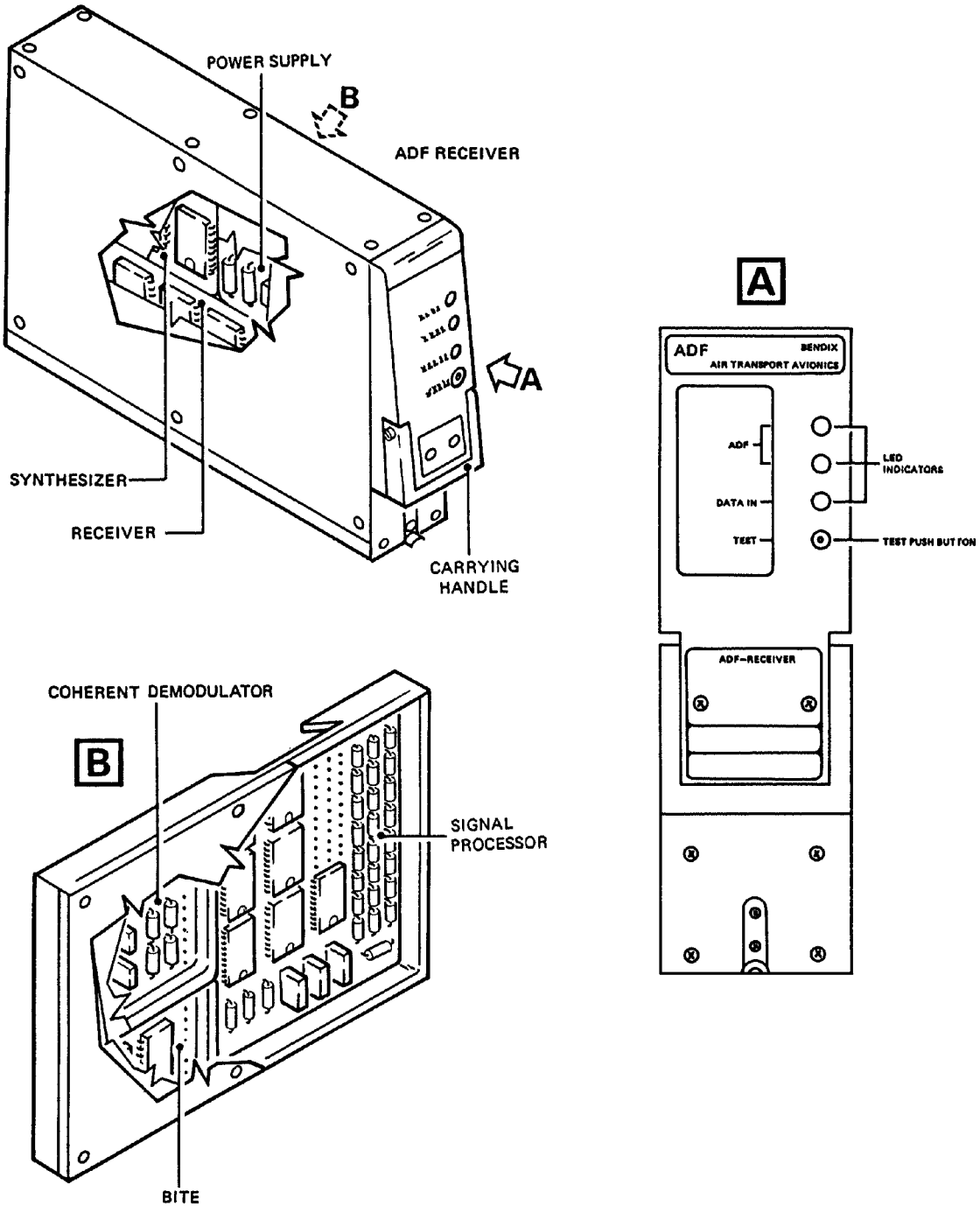
(2)Operation(Ref. Fig. 016)

The loop antennas' outputs are amplitude modulated by 96 Hz signals which are shifted 90° with respect to the others. The modulated out-



BM6 34 53 00 0 AMAO 00

ADF - Receiver
Figure 014



BM6 34 53 00 0 AMBO 00

ADF - Receiver
Figure 015

puts are then combined to produce a composite signal.
The phase relationship between this composite signal and the 96 Hz modulation is proportional to the bearing of the received station but with a phase shift of 180°. The phase shift is eliminated by combining the composite signal with the output from the sense antenna. The combined output is then filtered and mixed with an injected input from the synthesizer to produce a 15 MHz IF output.
The injected input to the mixer is tunable over the range 15.19 to 16.75 MHz corresponding to the receiver tuning range of 190 to 1750 kHz. The 15 MHz output is then mixed with a fixed 18.6 MHz signal from the synthesizer to produce a 3.6 MHz IF signal which is filtered and applied to a coherent detector which provides:
- an audio output to the aircraft audio integrating system
- an AGC signal for the IF stages
- a composite audio output which is applied to the signal processor through an A/D converter.

The signal processor determines the phase relationship between the 96 Hz signal and the composite audio output. The phase data, after correction for quadrantal error, is the station bearing data which is applied to the input/output processor for transmission through ARINC 429 data buses to the RMI and EFIS.
When non-directional A0/A1 signals are being received a 1 kHz signal from a beat frequency oscillator in the synthesizer is applied to the audio integrating system.
Quadrantal error correction is read by the input/output processor from the designated connector pins.
The fault memory supplies isolated module fault information during self-test, to the front panel LEDs, and during bench test, a history of internal fault monitoring to external test equipment. A record of faults, if detected, is stored in an 8 bit flight segment byte. A flight segment is the period between takeoff and landing. The memory is capable of storing 49 flight segments.
The fault memory can be programed during a bench test to a special combination of fault sequences of the last 4 flights.
If the occured faults are identical with the programed, the LRU STATUS FAIL LED is lit during the self-test cycle.

**ON A/C 001-100,

(2)Operation (Ref. Fig. 017)
The control unit initiates operation by coupling frequency data (chanel select) and functional mode data to the signal processor in the ADF receiver. The 32-bit serial frequency function data word is received by the processor. The data is examined and if it is valid data, a 20-bit serial data word is coupled to the synthesizer module. The 20-bit serial data word contains the selected channel frequency data for VCO control as well as ADF/ANT and BFO mode select data.
The incoming radio beacon signal is received by the ADF Antenna. Three seperate signals are coupled to the receiver module:
- Sense signal
- A loop signal proportional in amplitude to the cosine of the angle

through the centerline of the aircraft to the radio beacon.
- A loop signal proportional to the sine.

When the ADF system is in ANT mode, the sense signal is processed through the receiver in conventional superheterodyne fashion, and an audio output signal is coupled to the aircraft audio system.
When the ADF system is in ADF mode, the loop signals are balance modulated by reference 31 Hz modulation control signals. The 31 Hz modulation control signal is composed of four selected phases in quadrature. The balance modulated loop signals are summed together with the sense signal in a controlled phase relationship to form a composite phase modulated carrier signal. The signal is then coupled through the receiver to IF circuits and then to the coherent demodulator module.
The coherent demodulator senses the presence of a signal from the IF circuit and phase locks a tracking VCO to the signal. The phase modulation component of the signal is recovered from the VCO phase lock circuit. The recovered signal contains the original bearing information received by the ADF antenna. This signal is filtered and then coupled to the processor module. The recovered bearing data signal is compared to the reference modulation control signal in the signal processor and converted to a 12-bit bearing data field. The signal processor contains a microprocessor circuit which filters the incoming signal to reduce the effect of noise components.
A correction is made for quadrantal error (QE) due to signal distortion by the aircraft structure. ARINC defined connections are made at the rear connector of the ADF receiver to provide for the desired QE correction. A connection is also provided to allow antenna location on the top or bottom of the aircraft fuselage.
A 32-bit ARINC 712 defined bearing data word containing bearing data, source destination identifier (SDI) information, status information, and a parity bit is assembled in the signal processor module for output to the ARINC 429 indicator.

(3)Monitoring

A part of the microprocessor program is used for internal function monitoring.
The processor activates all 90 seconds for 1.5 seconds a test and calibration procedure. For this time the outputs are frozen at the last value. After this time normal operation is resumed. In the 1.5 second event especially the filters in the demodulator circuits are calibrated.
The input multiplexer receives several signals from the receiver which are used for monitoring. These signals are converted and digitized for processing.

**ON A/C 101-200,

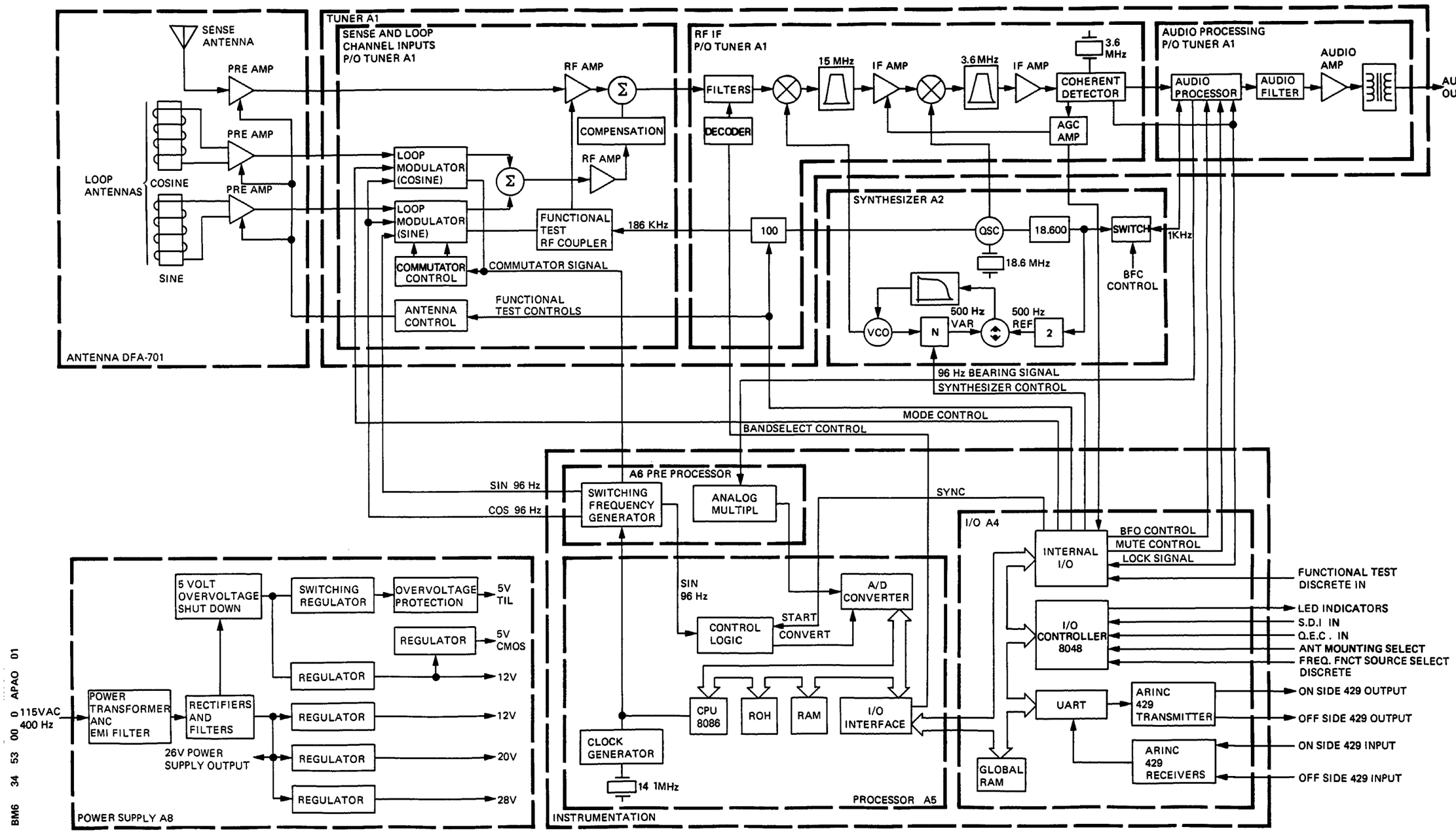
(Ref. Fig. 016)

**ON A/C 001-100,

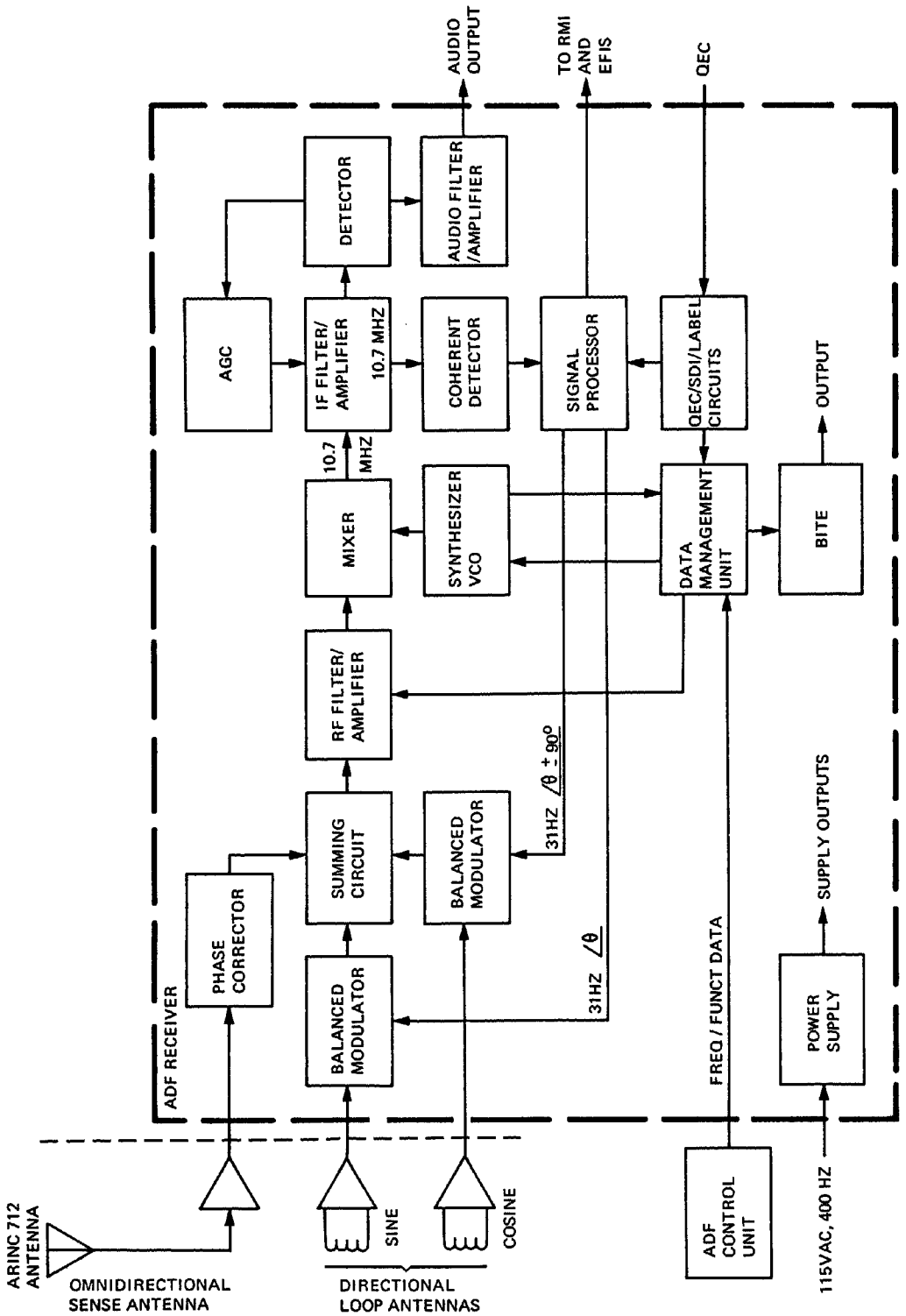
(Ref. Fig. 017)

B. Control Unit (Ref. Fig. 018)

The control unit conforms to the ARINC 712 specification. The front panel



ADF - Internal Block Diagram
Figure 016



BM6 34 53 00 0 APB0 00

ADF - Internal Block Diagram
Figure 017

is integrally lit by clear 5 V lamps.
Features are:
- Two liquid crystal frequency display windows. The frequency range of the unit is 190 thru 1750.5 kHz with 0.5 kHz spacing.
- Two frequency selectors with three concentric knobs each. The inner knob controls the fractions and units of kHz, the middle knob controls the tens of kHz and the outer knob controls the hundreds of kHz.
- A transfer (TFR) switch which is used to select one of two selected frequencies to tune the receiver.
- Two green transfer lights which indicate the selected frequency used to tune the receiver.
- A BFO/OFF switch which enables the reception of unmodulated A0/A1 signals in the BFO position or modulated signals in the OFF position.
- An ANT/ADF switch which can be used if only reception of audio without direction finding is required (ANT position).
- The processor in the unit converts the selected frequency into ARINC 429 format for transmission to the ADF receiver and supplies selected frequency data to drive the liquid crystal displays.

**ON A/C 101-200,

B. Control Unit (Ref. Fig. 019)
The control unit conforms to the ARINC 712 specification. The front panel is integrally lit by clear 5 V lamps.
Features are:
- Two liquid crystal frequency display windows. The frequency range of the unit is 190.0 thru 1750.5 kHZ with 0.5 kHz spacing.
- Two frequency selectors with three concentric knobs each. The inner knob controls the fractions and units of kHz, the middle knob controls the tens of kHz and the outer knob controls the hundreds of kHz.
- A transfer (TFR) switch which is used to select one of two selected frequencies to tune the receiver.
- Two green transfer lights which indicate the selected frequency used to tune the receiver.
- An A1/NORM switch which enables the selection of unmodulated A0/A1 signals in the A1 position or modulated signals in the NORM position.
- The processor in the unit converts the selected frequency into ARINC 429 format for transmission to the ADF receiver and supplies selected frequency data to drive the liquid crystal displays.

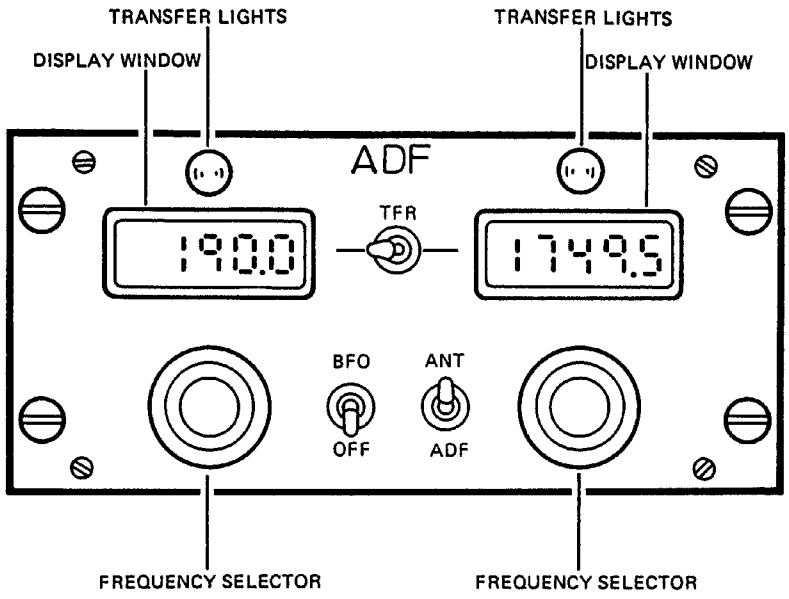
**ON A/C 001-100,

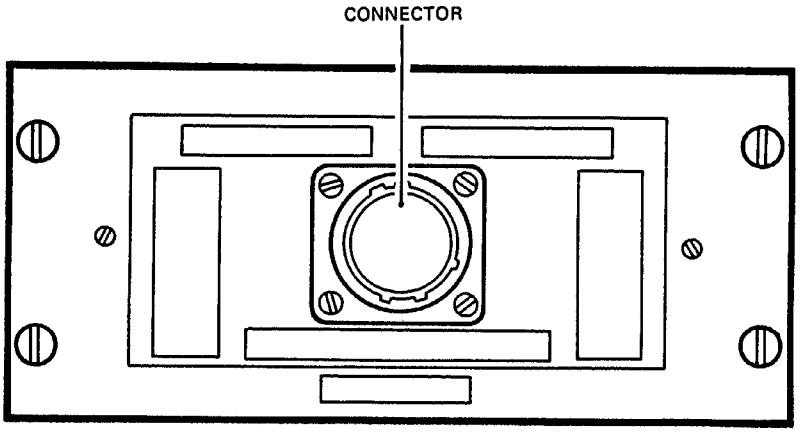
(Ref. Fig. 018)

**ON A/C 101-200,

(Ref. Fig. 019)

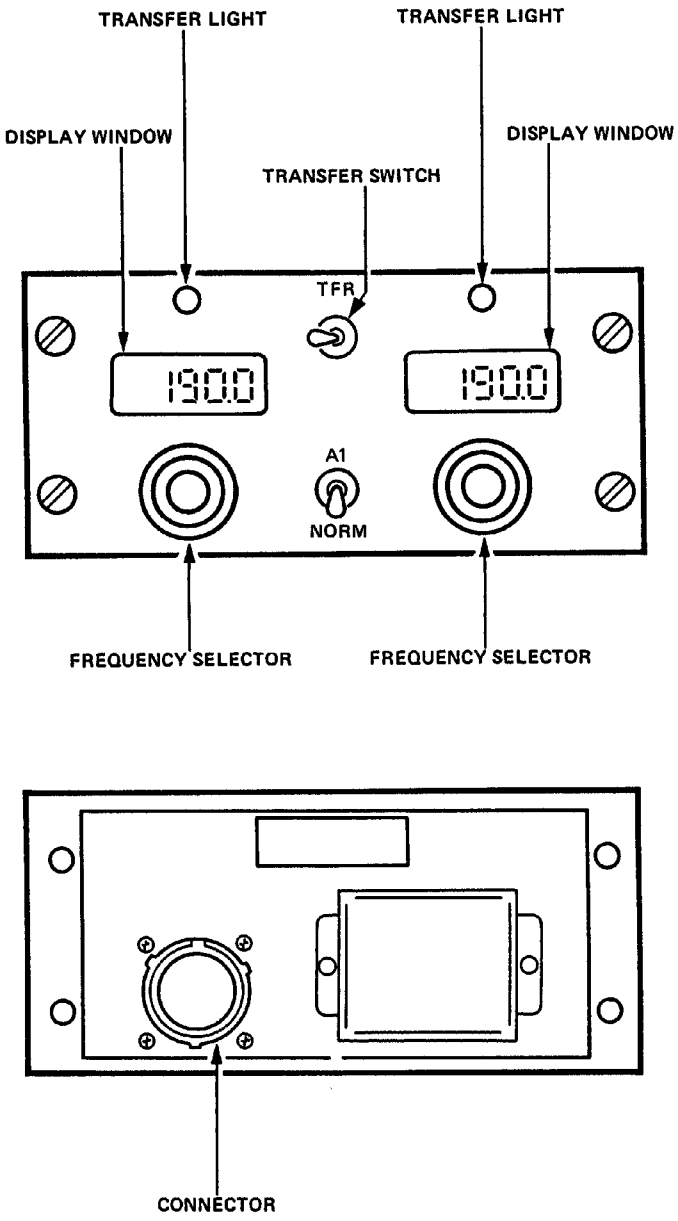
**ON A/C ALL





BM6 34 53 00 0 AQAO 00

ADF - Control Unit
Figure 018



BM6 34 53 00 0 AQBO 00

ADF - Control Unit
Figure 019

C. Loop and Sense Antenna
The combined loop and sense antenna operates in the 190 to 1750 kHz frequency range and consists of the following components enclosed in a fibreglass housing:
- A vertically polarized sense antenna which is omnidirectional in the horizontal plane.
- Two horizontally polarized orthogonal loop antennas which are directional in the horizontal plane.
- A test loop which enables a self-test of the antenna.
- A printed circuit board which contains three preamplifiers used to amplify the loop and sense antenna signals. The preamplifiers are energized by +/- 12 V DC from the ADF receiver.
- The output impedance of the antenna is 78 Ohm and the VSWR 1.2:1.
  NOTE : The connection between antenna and receiver is made with a special double shielded cable. A quadrantal error correction is realized by programming connector pins of the receiver.
  (Ref. Fig. 020)

5. System Operation

A. Energization
The ADF systems are energized when their busbars are supplied with 115 VAC and circuit breakers are closed.
For ADF operation all related components such as RMIs, EFIS SGUs, NDs etc. must be energized too.

**ON A/C 001-100,

B. Control
Frequency selection:
There are two frequency selectors on each control unit to select two different ADF frequencies which are displayed in seperate windows. The TFR toggle switch between them allows the choice of which frequency is used for tuning the receiver (green light indication). ADF 1 (Capt.) activates the single pointers on both RMIs and ADF 2 (F/O) activates the double pointers on both RMIs.
The frequency selectors consist of:
- the inner knob which is adjustable in steps of 0,5 kHz,
- the middle knob which is adjustable in steps of 10 kHz,
- the outer knob which is adjustable in steps of 100 kHz.

There is a toggle switch on the control unit to select either BFO or OFF.
- BFO: The beat frequency oscillator is used to receive the signal from the beacon transmitter (type A0 or A1 modulation). In this case it permits creating a 1000 Hz AF signal which is available (after amplification) at the audio output.
- OFF: The BFO is deactivated.

There is a toggle switch on the control unit to select either:
- ADF: Normal ADF operation.
- ANT: Only audio reception, without direction finding, is possible.

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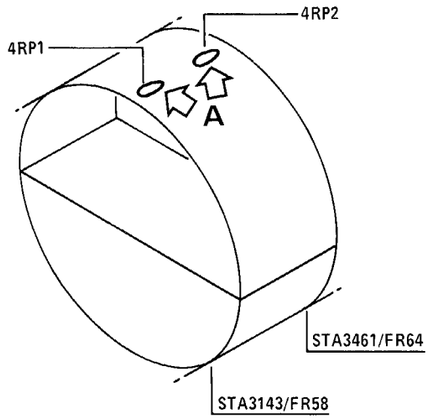
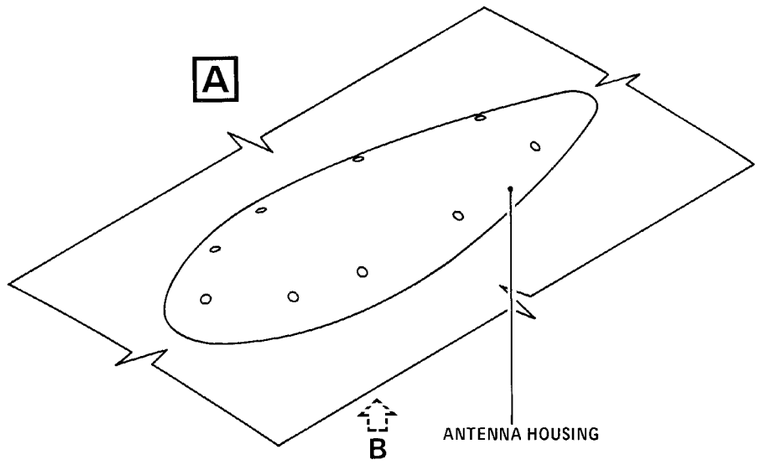
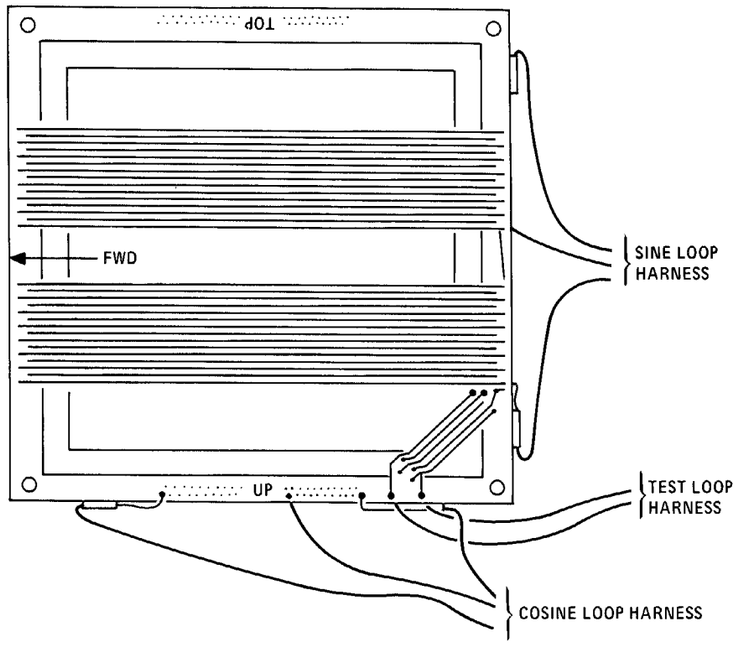
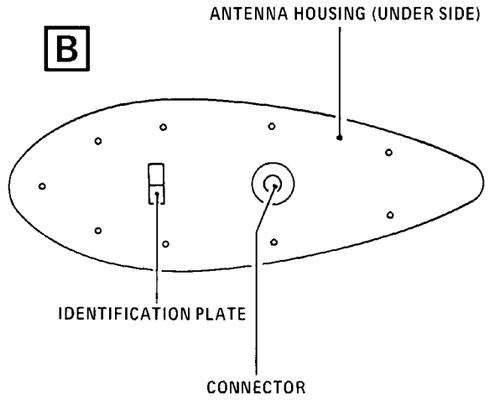
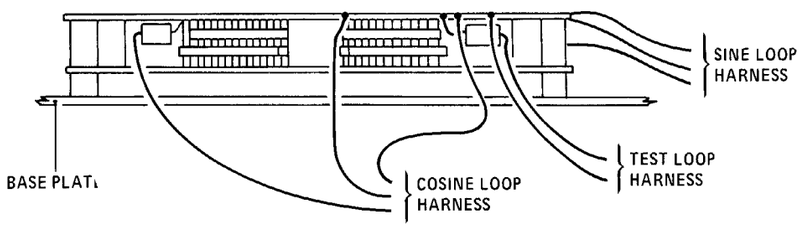
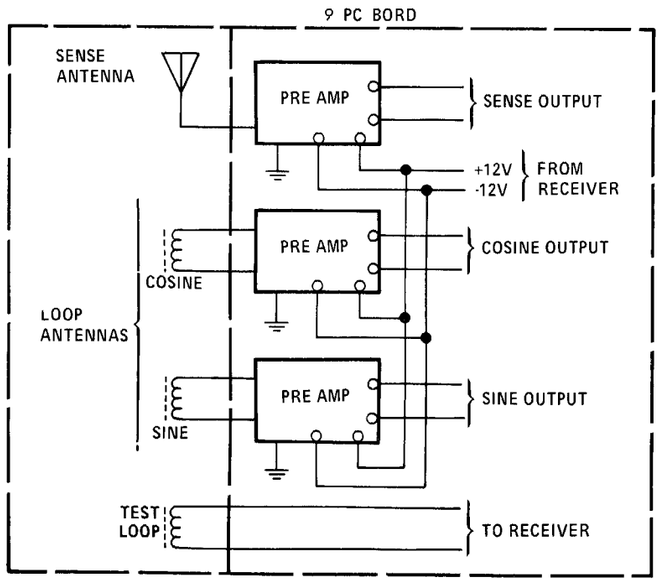












BM6 34 53 00 0 ARM0

ADF - Loop and Sense Antenna
Figure 020

**ON A/C 101-200,

B. Control
Frequency selection:
There are two frequency selectors on each control unit to select two different ADF frequencies which are displayed in seperate windows. The TFR toggle switch between them allows the choice of which frequency is used for tuning the receiver (green light indication). ADF 1 (Capt.) activates the single pointers on both RMIs and ADF 2 (F/O) activates the double pointers on both RMIs.
The frequency selectors consist of:
- the inner knob which is adjustable in steps of 0,5 kHz,
- the middle knob which is adjustable in steps of 10 kHz,
- the outer knob which is adjustable in steps of 100 kHz.

There is a toggle switch on the control unit to select either A1 or NORM.
- A1: The beat frequency oscillator is used to receive the signal from the beacon transmitter (type A0 or A1 modulation). In this case it permits creating a 1000 Hz AF signal which is available (after amplification) at the audio output.
- NORM: The beat frequency oscillator is deactivated.

**ON A/C ALL

C. Indication
The bearing information is indicated:
On the RMIs:
- Single pointers are active when ADF 1 is energized and double pointers are active when ADF 2 is energized.
- In case of system failure the referring ADF flag appears and pointer is in 3 o'clock position.
- In case of NCD the referring pointers are in 3 o'clock position, no flag appears.

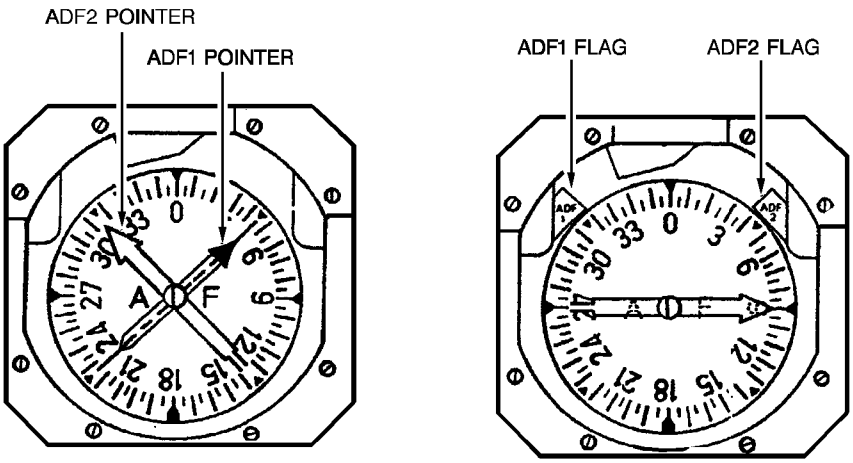
On the NDs:
- ADF is mainly displayed in ROSE mode; ADF 1 and 2 bearings are displayed by single and double pointers respectively.
- In the event of a system failure, or there is no computed data, the corresponding pointer disappears.

**ON A/C 001-100,

(Ref. Fig. 021)

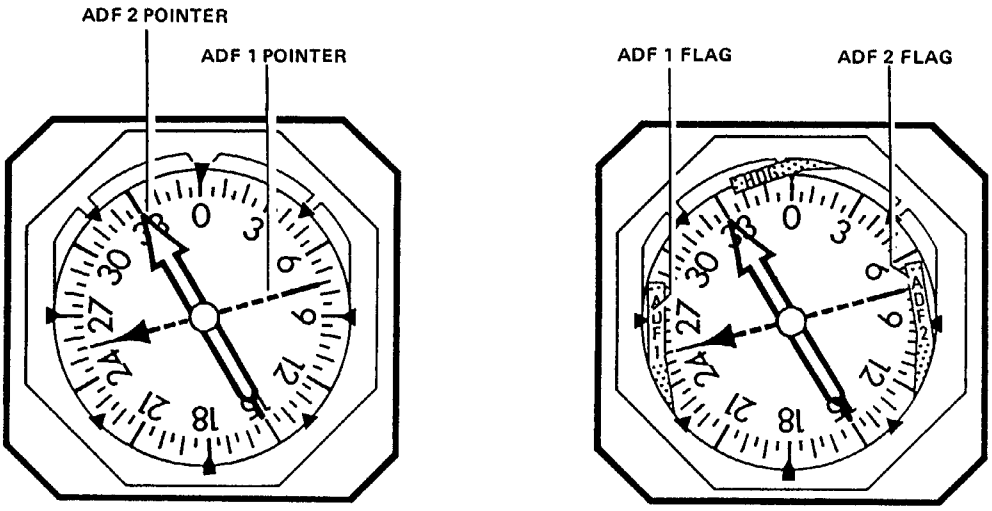
**ON A/C 101-200,

(Ref. Fig. 022)



BM5 34 53 00 0 ATM0 01

ADF - Radio Magnetic Indicator
Figure 021



BM6 34 53 00 0 ATRO 00

ADF - Radio Magnetic Indicator
Figure 022

**ON A/C ALL

(Ref. Fig. 023)

D. Lighting
The control unit is integrally lit. The light dimming can be continuously remotely controlled via turn knobs on panel 414VU.
The brightness of the transfer lamps is variable by using the switch 'TEST/BRT/DIM' on the 'ANN LT' panel 436VU.

E. Audio Control
The ADF audio signal is audible in the headsets and loudspeakers controlled by the audio integrating system. The ADF button must be pressed and adjusted to the required volume.

**ON A/C 101-200,

6. Test

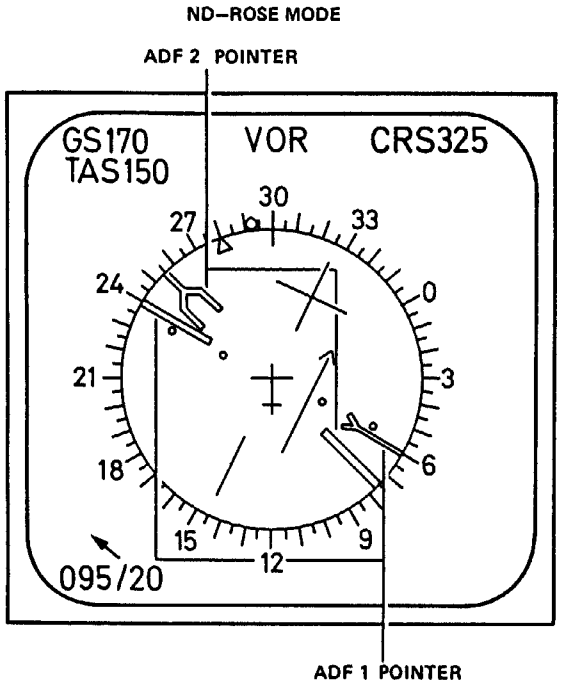
A. The selftest (BITE) is activated by pressing the ADF button on the AVIONICS SYS TEST Panel (47OVU) or the TEST button on the ADF receiver front panel.
All LEDs on the LRU come on for approx. 5 seconds, then all LEDs go off for approx. 3 seconds, then the green LRU STATUS PASS LED comes on for approx. 7 seconds, then goes off.
At the same time the RMI/ND will show:

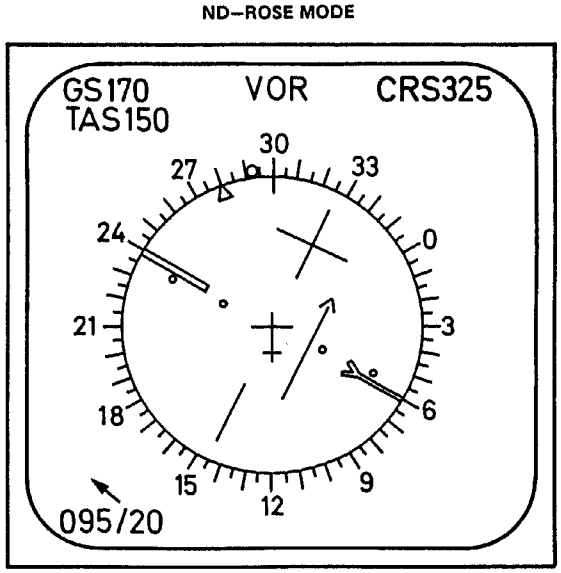
No.	Message	Duration	RMI	ND
1	System failure warning	approx. 5 sec.	ADF flag appears pointer in 3 o'clock position	ADF pointer disappears
2	NCD	approx. 3 sec.	ADF flag disappears pointer in 3 o'clock position	ADF pointer is not visible
3	simul. bearing	approx. 7 sec.	Pointer in half past 4 position	Pointer in half past 4 position

**ON A/C 001-100,

6. Test

A. The selftest (BITE) is activated by pressing the ADF button on the AVIONICS SYS TEST Panel (47OVU) or the TEST button on the ADF receiver front panel.
All LEDs on the LRU come on for approx. 3 seconds, then all LEDs go off





BM6 34 53 00 0 AVBO 00

ADF - Bearing Indication on EFIS ND
Figure 023

for approx. 3 seconds, then the green ADF LED comes on until the TEST button is released.
At the same time the RMI/ND will show:

No.	Message	Duration	RMI	ND
1	System failure warning	approx. 3 sec.	ADF flag appears pointer in 3 o'clock position	ADF pointer disappears
2	NCD	approx. 3 sec.	ADF flag disappears pointer in 3 o'clock position	ADF pointer is not visible
3	simul. bearing	until TEST is released	Pointer in half past 4 position	Pointer in half past 4 position

1. Operational Test

A. Reason for the Job
(1)To ensure correct operation of ADF system.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz
(2)	Headset, 600

Referenced Procedures

- 23-51-00, P. Block 501	Audio Integrating
- 24-41-00, P. Block 301	AC External Power Control
- 34-71-00, P. Block 501	EFIS - General

C. Procedure
(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Energize the EFIS (Ref. 34-71-00, P. Block 501).
(d)Make certain that the following circuit breakers are closed:

	PANEL	SERVICE	IDENT.	LOCATION
R	21VU	RADIO NAV & COM/NAV CLT PNL LT & SELCAL	3RW	D 6
R	21VU	RADIO NAV & COM/ADF 1	10RP1	D 1
R	21VU	RADIO NAV & COM/ADF 2	10RP2	D14
	21VU	NAVIGATION/CAPT/RMI/ADF	46FN1	F 5
	21VU	NAVIGATION/F/O/RMI/ADF	46FN2	F 9

(e)Energize the audio integrating system (Ref. 23-51-00, P. Block 501).
(f)Connect headset to associated connector on Captain's jack box.
(g)Select ADF mode on Captain's audio selector panel and place VOICE/IDENT switch in IDENT position.
(h)Select ROSE mode on EFIS control panels.

NOTE : The test described below is for ADF 1. The ADF 2 is identical, for testing refer to information shown in brackets.

**ON A/C 101-200,

(2)Test

ACTION	RESULT
1. On ADF control unit, 3RP1 (3RP2): - place TFR toggle switch in LH position, place A1/NORM switch in NORM position, select, using LH selector, a frequency of a local A2/A3-NDB station with amplitude modulated signal or a broadcast station.	On ADF control unit 3RP1 (3RP2): - green light above LH window comes on. On ADF RMIs: - ADF1 (ADF2) flags are out of view. - red single pointers (green double pointers) indicate direction of selected station. On EFIS ND units: - magenta (green) ADF pointers indicate direction of selected station. On headset: - audio signal voice and/or identification is heard.
2. On panel 47OVU: - press and hold AVIONICS SYS TEST/ ADF1 (ADF2) pushbutton.	For approx. 5 seconds a failure signal is transmitted. On ADF RMIs (Captain and F/O): ADF1 (ADF2) system failure warning flags appear. - red single (green double) pointers turn to 135 deg. position (which corresponds to half past four clock position). On EFIS ND units: - magenta (green) ADF pointers disappear. On headset: - 1 kHz audio signal is heard. In the next approx. 3 seconds a no computed data signal is transmitted. On the ADF RMIs: - ADF1 (ADF2) flags disappear and red (green) pointers remain at 135 deg. position. On EFIS ND units: - magenta (green) ADF pointers are invisible. For the next approx. 7 seconds a simulated bearing signal is displayed. On ADF RMIs: - red (green) pointers turn and remain at half past 4 position. On EFIS ND units: - magenta (green) ADF pointers appear at half past 4 position. After approx. 15 seconds, test

ACTION	RESULT
	sequence finishes automatically. On **ADF RMIs**: - red (green) pointers turn back to the initial position. On **EFIS ND** units: - magenta (green) **ADF** pointers appear again at the initial position. On headset: - 1 kHz audio tone is superseded by before test audio signal.
- release **TEST** pushbutton.	
3. On **ADF** control unit **3RP1 (3RP2)**: - place **TFR** toggle switch in the **RH** position and, using **RH** selector, select a frequency not corresponding to a local ground station.	On **ADF** control unit **3RP1 (3RP2)**: - green light changes to **RH** window. On **ADF RMIs**: - red single (green double) pointers turn to 3 o'clock position. On **EFIS ND** units: - magenta (green) **ADF** pointers disappear. On headset: - no audio signal is heard.
- using **RH** selector, select a frequency of a local **A1-NDB** station (carrier frequency only). or an **A2/A3-NDB** station with amplitude modulated signal.	On **ADF RMIs**: - red single (green double) pointers indicate direction of selected station. On **EFIS ND** units: - magenta (green) **ADF** pointers indicate direction of selected station. On headset: - no audio signal is heard in case of **A1-NDB**, - audio signal voice and/or identification is heard in case of **A2/A3-NDB**.
- place **A1/NORM** switch in **A1** position.	On headset: - 1kHz audio signal is heard.
4. On Captain's audio selector panel: - adjust **ADF1 (ADF2)** potentiometer.	On headset: - check that audio tone changes progressively and no crackling is heard.
- place **VOICE/IDENT** toggle switch in **VOICE** position.	- check that 1 kHz tone volume decreases.

ACTION	RESULT
5. On ADF control unit 3RP1 (3RP2): - place the TFR toggle switch in LH position.	On ADF control unit 3RP1 (3RP2): - green light changes to LH window. On ADF RMIs: - red single (green double) pointers indicate direction of selected station. On EFIS ND units: - magneta (green) ADF pointers indicate direction of selected station.
6. On Captain's audio selector panel: - place VOICE/IDENT switch in IDENT position.	On headset: - 1 kHZ signal is heard at a preset volume.
7. On control unit 3RP1 (3RP2): - place A1/NORM switch in NORM position.	On headset: - 1 kHz tone is no longer heard. - voice signal is heard, and if existing, ident signal also.
8. On Captain's audio selector panel: - adjust ADF1 (ADF2) potentiometer and set loudspeaker control knob to high level.	On headset and/or loudspeaker: - check that audio tone changes progressively in volume and no crackling is heard.
9. On all other available jack boxes: - connect headset successively and set respective loudspeaker control knob to high level.	On headset and/or loudspeaker: - check that audio tone changes progressively in volume and no crackling is heard.
10. On ADF1 (ADF2) receiver front panel: - press and hold TEST pushbutton.	On ADF1 (ADF2) receiver front panel: - for approx. 5 seconds all LEDs come on. - for the next 3 seconds approx., all LEDs go off. - green LED LRU STATUS PASS comes on for approx. 7 seconds, then goes off.
- release TEST pushbutton.	

R **ON A/C 001-100,

(2)Test

ACTION	RESULT
1. On ADF control unit, 3RP1 (3RP2): - place TFR toggle switch in LH position, place BFO/OFF	On ADF control unit 3RP1 (3RP2): - green light above LH window comes on.

ACTION	RESULT
switch in OFF position, place ANT/ADF switch in ADF position, select, using LH selector, a frequency of a local A2/A3-NDB station with amplitude modulated signal or a broadcast station.	On ADF RMIs: - ADF1 (ADF2) flags are out of view. - single pointers (double pointers) indicate direction of selected station. On EFIS ND units: - magenta (green) ADF pointers indicate direction of selected station. On headset: - audio signal voice and/or identification is heard.
2. On panel 47OVU: - press and hold AVIONICS SYS TEST/ ADF1 (ADF2) pushbutton for more than 10 seconds.	For approx. 3 seconds a failure signal is transmitted. On ADF RMIs (Captain and F/O): - ADF1 (ADF2) system failure warning flags appear. On EFIS ND units: - magenta (green) ADF pointers disappear. On headset: - 1 kHz audio signal is heard. In the next approx. 3 seconds a no computed data signal is transmitted. On EFIS ND units: - magenta (green) ADF pointers are invisible. Until TEST pushbutton is released a simulated bearing signal is displayed. On ADF RMIs: - single (double) pointers remain in their previous position. On EFIS ND units: - magenta (green) ADF pointers appear at half past 4 position.
- release TEST pushbutton.	On ADF RMIs: - single (double) pointers turn back to the initial position. On EFIS ND units: - magenta (green) ADF pointers appear again at the initial position. On headset:

ACTION	RESULT
	- 1 kHz audio tone is superseded by before test audio signal.
3. On ADF control unit 3RP1 (3RP2): - place TFR toggle switch in the RH position and using RH selec tor select a frequency not corresponding to a local ground station.	On ADF control unit 3RP1 (3RP2): - green light changes to RH window. On EFIS ND units: - magenta (green) ADF pointers disappear. On headset: - no audio signal is heard.
- using RH selector, select a frequency of a local A1-NDB station (carrier frequency only). or an A2/A3-NDB station with amplitude modulated signal.	On ADF RMIs: - single (double) pointers indicate direction of selected station. On EFIS ND units: - magenta (green) ADF pointers indicate direction of selected station. On headset: - no audio signal is heard in case of A1-NDB, - audio signal voice and/or identification is heard in case of A2/A3-NDB.
- place BFO/OFF switch in BFO position.	On headset: - 1kHz ident audio signal is heard.
4. On Captains's audio selector panel: - adjust ADF1 (ADF2) potentiometer.	On headset: - check that audio tone changes progressively and no crackling is heard.
- place VOICE/IDENT toggle switch in VOICE position.	- check that 1 kHz tone volume decreases.
5. On ADF control unit 3RP1 (3RP2): - place ANT/ADF switch in ANT position	On EFIS ND units: - magenta (green) ADF pointers disappear.
- place the TFR toggle switch in LH position.	On ADF control unit 3RP1 (3RP2): - green light changes to LH window.
6. On Captain's audio selector panel: - place VOICE/IDENT switch in IDENT position.	On headset: - 1 kHz signal is heard in normal preset volume.
7. On control unit 3RP1 (3RP2): - place BFO/OFF switch in OFF posi-	On headset: - 1 kHz tone is no longer heard.

ACTION	RESULT
tion.	- voice signal is heard, and if existing, ident signal also.
- place **ANT/ADF** switch in **ADF** position.	On **ADF RMIs**: - single (double) pointers indicate direction of selected station. On **EFIS ND** units: - magenta (green) **ADF** pointers indicate direction of selected station.
8. On Captain's audio selector panel: - adjust **ADF 1 (ADF2)** potentiometer and set loudspeaker control knob to high level.	On headset and/or loudspeaker: - check that audio tone changes progressively in volume and no crackling is heard.
9. On all other available jack boxes: - connect headset successively and set respective loudspeaker control knob to high level.	On headset and/or loudspeaker: - check that audio tone changes progressively in volume and no crackling is heard.
R 10. On **ADF1 (ADF2)** receiver front panel: - press and hold **TEST** pushbutton for more than 10 seconds.	On **ADF1 (ADF2)** receiver front panel: - for approx. 3 seconds all LEDs come on. - for the next 3 seconds approx., all LEDs go off. - green **LED ADF** comes on until **TEST** pushbutton is released.
- release **TEST** pushbutton.	

R ****ON A/C ALL**

(3)Close-Up
(a)Disengage **ADF** mode on the audio selector panel.
(b)Remove headset from associated jack box.
(c)De-energize **EFIS** (Ref. 34-71-00, P. Block 501).
(d)De-energize the aircraft electrical network and disconnect electrical ground power unit (Ref. 24-41-00, P. Block 301).
(e)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

ADF LOOP AND SENSE ANTENNA - REMOVAL/INSTALLATION

R **WARNING** : CLEANING AGENT (MAT. NO. 11-026) IS DANGEROUS. AVOID INHALING FUMES. USE IN WELL VENTILATED AREA ONLY. IT IS HIGHLY FLAMMABLE AND A SKIN IRRITANT. WEAR PROTECTIVE GLOVES OR USE A BARRIER CREAM. WASH IMMEDIATELY WITH CLEAN WATER, IF SKIN IS SPLASHED WITH SOLVENT.

1. Equipment and Materials

ITEM	DESIGNATION
A.	Access Platform, 7.90 m (26 ft.)
B. Material No. 09-018	Sealants (Ref. 20-31-00)
	or
Material No. 09-016	Sealants (Ref. 20-31-00)
R C. Material No. 11-026	Cleaning Agents (Ref. 20-31-00)
D. Material No. 16-003	Structure Paints (Ref. 20-31-00)
E.	Blanking Cap
F.	Yarn - Nylon
G.	Nonmetallic Scraper

Referenced Procedure	
- 34-53-00, P. Block 501	ADF

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COMM/ADF1	10RP1	D 1
21VU	RADIO NAV & COMM/ADF2	10RP2	D14

(2)Position access platform.

B. Removal (Ref. Fig. 401)

NOTE : Removal procedure of ADF1 and ADF2 antennas is identical.

R **WARNING** : CLEANING AGENT (MAT. NO. 11-026) IS DANGEROUS.

(1)Remove sealant from screw recesses and screw heads.

(2)Unscrew captive screws (5).

(3)Remove antenna (1) from fuselage far enough to have access to connector (4).

(4)Disconnect connector (4) and fully remove antenna (1).

(5)Fit blanking cap to connector (4).

(6)Remove gasket and old sealant from fuselage using cleaning agent

R (Mat. No. 11-026) and nonmetallic scraper.

C. Installation (Ref. Fig. 401)

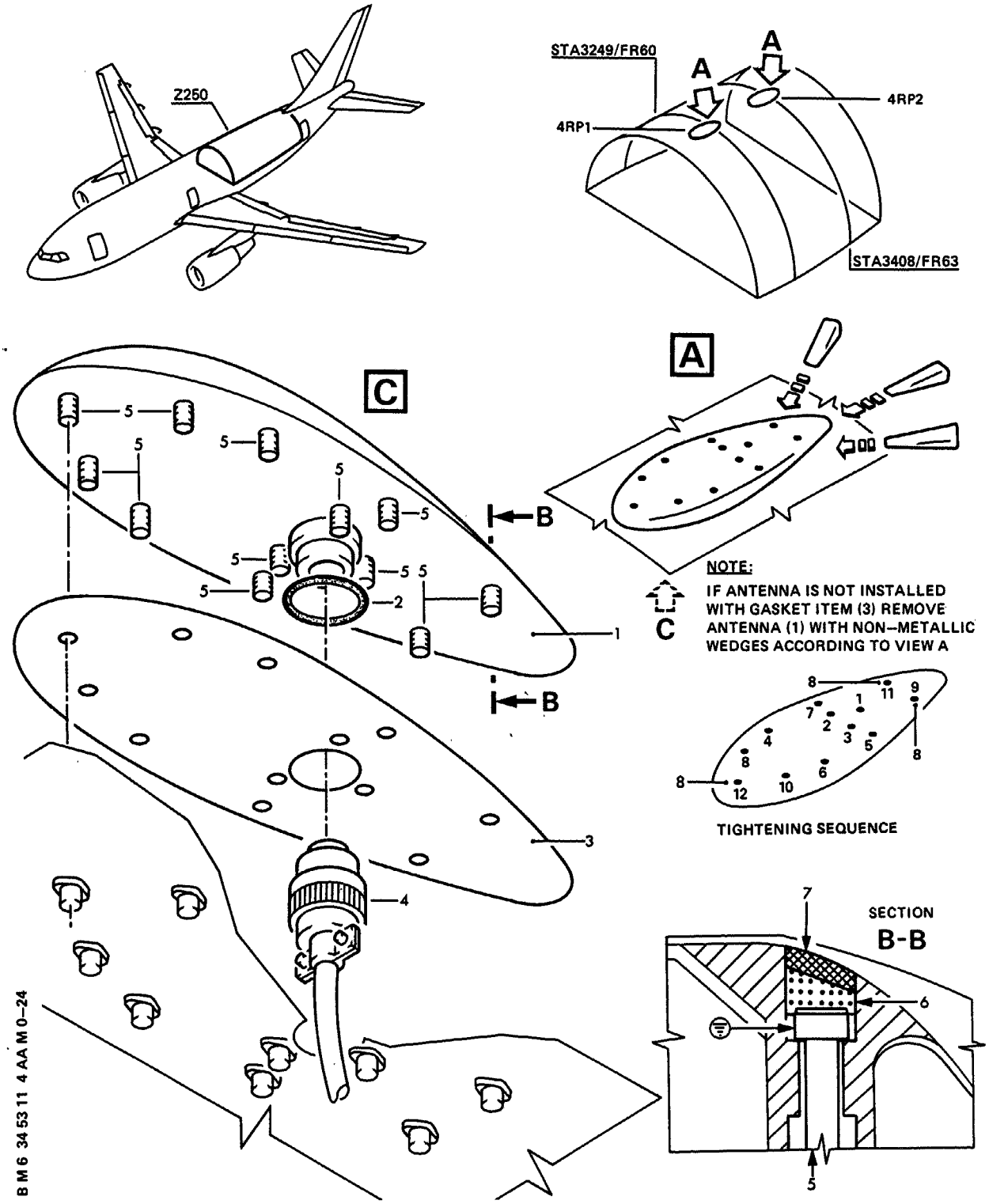
NOTE : Installation procedure of ADF1 and ADF2 antennas is identical.

(1)Place gasket (3) on fuselage and align screw holes.

(2)Ensure correct O-ring (2) installation and connect connector (4) to antenna (1).
(3)Position and install antenna (1) with the captive screws (5) on the fuselage and then tighten in the correct order.
(4)Paint screw heads (5) with finish coat (Mat. No. 16-003).
(5)Fill countersinks (8) with sealant (7). All other contersinks fill with yarn (6) and sealant (7) (Mat. No. 09-018) or (Mat. No. 09-016) and smooth to contour.
(6)Apply sealant (Mat. No. 09-018) or (Mat. No. 09-016) to antenna base-line, to make a sealant bead.
(7)After sealant has cured apply surface treatment corresponding to A/C finish.
R NOTE : It is not mandatory to paint the sealant around the base of the
R antenna and on the head of the screws.
(8)Remove safety clips and tags and close circuit breakers 10RP1 and 10RP2. (Ref. Fig. 401)

D. Test
(1)Carry out ADF operational test (Ref. 34-53-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Remove access platform.



ADF LOOP and SENSE Antenna
Figure 401

ADF CONTROL UNIT 3RP1 (3RP2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-53-00, P. Block 501	ADF

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up

Open, safety and tag the following circuit breakers

(1)For ADF control unit 3RP1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/ADF 1	1ORP1	106/D 1
21VU	RADIO NAV & COM/NAV-CTL PNL-LT & SELCAL	3RW	106/D 6

(2)For ADF control unit 3RP2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/NAV-CTL PNL-LT & SELCAL	3RW	106/D 6
21VU	RADIO NAV & COM/ADF2	1ORP2	106/D14

B. Removal

(1)Unlock the four quick release fasteners (1).

(2)Withdraw ADF control unit (2) from housing so as to disconnect electrical connectors (3).

(3)Disconnect electrical connectors (3) and remove ADF control unit (2).

(4)Blank electrical connectors (3).

C. Installation

(1)Clean and inspect ADF control unit interface and/or adjacent area.

(2)Remove blanking cap from electrical connectors (3) and make certain that connector end is in correct condition.

(3)Position ADF control unit (2) and connect electrical connectors (3).

(4)Install ADF control unit.

(5)Lock the four quick release fasteners (1).

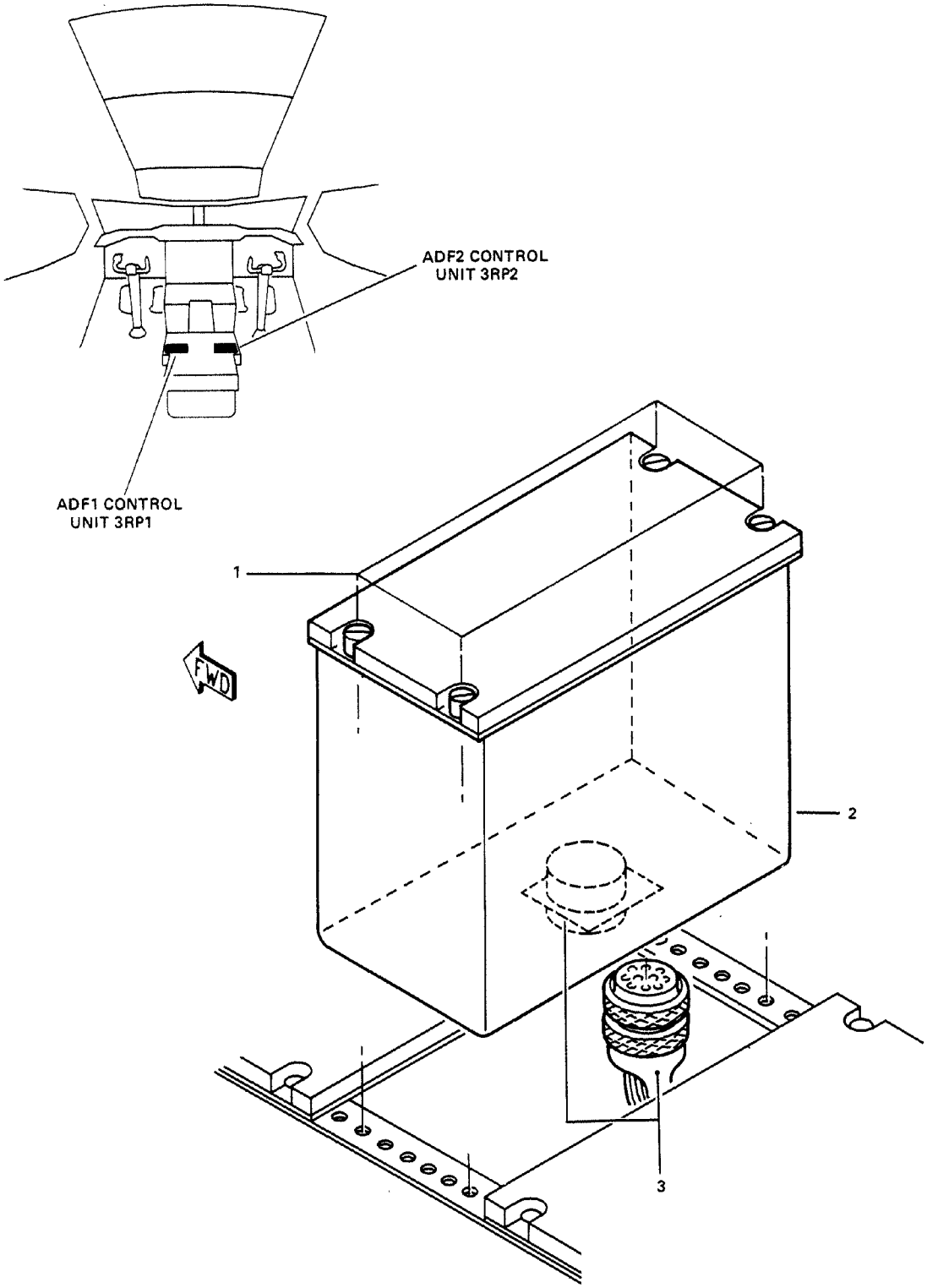
(6)Remove safety clips and tags and close circuit breakers :

(a)For ADF control unit 3RP1 : 1ORP1 and 3RW.

(b)For ADF control unit 3RP2 : 1ORP2 and 3RW.

D. Test

Carry out operational test of ADF system (Ref. 34-53-00, P. Block 501).



BM5 34 53 13 4 TGM2 00

ADF Control Unit
Figure 401

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

ADF RECEIVER 1RP1 (1RP2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-53-00, P. Block 501	ADF

R (Ref. Fig. 401)

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For ADF1 receiver 1RP1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO - NAV & COM/ADF1	1ORP1	106/D01

(b)For ADF2 receiver 1RP2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO - NAV & COM/ADF2	1ORP2	106/D14

(2)Open door 121BL to gain access to avionics compartment.

B. Removal

(1)Unscrew knurled nut on tenon (4). Tilt tenon (4) downwards to disengage it from stud (3).

(2)Raise handle (2) to withdraw ADF receiver (1) from rack (5). Take care not to damage electrical connectors (6).

(3)Blank electrical connectors (6).

(4)Remove ADF receiver (1).

C. Installation

(1)Clean and inspect ADF receiver interface and/or adjacent area.

(2)Remove blanking caps and check for correct condition and cleanliness of electrical connectors (6).

(3)Position ADF receiver (1) in rack (5) carefully.

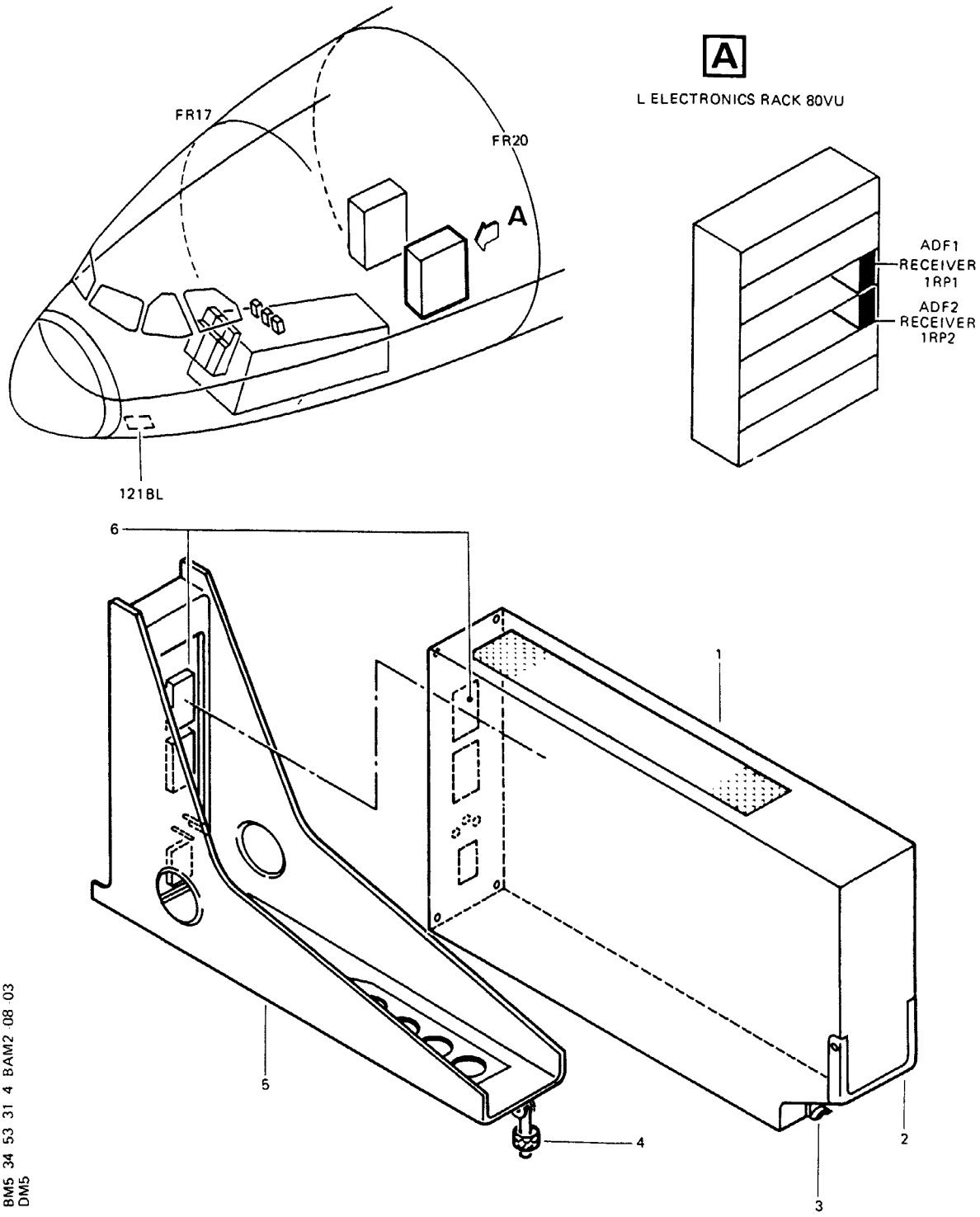
(4)Tilt tenon (4) upwards and lift knurled nut into position on stud (3). Tighten.

(5)Lower handle (2).

(6)Remove safety clips and tags and close circuit breakers :

(a)For ADF1 receiver 1RP1 : 1ORP1

(b)For ADF2 receiver 1RP2 : 1ORP2.



ADF Receiver
Figure 401

D. Test
Carry out operational test of ADF receiver (Ref. 34-53-00, P. Block 501)

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.

VOR - DESCRIPTION AND OPERATION

1. General

The VOR system is a medium range radio navigation aid.
The aircraft is equipped with two VOR systems capable of accepting ground station signals in the frequency range of 108 MHz to 117.95 MHz.
These signals are processed and conditioned to provide the crew with:
- identification of a selected ground station,
- indication of the aircraft's position with respect to the station (bearing information),
- indication of course deviation from a selected course and ''TO/FROM'' information.

2. Component Location

**ON A/C 001-100,

(Ref. Fig. 001)

**ON A/C 101-200,

(Ref. Fig. 002)

**ON A/C 001-100,

(Ref. Fig. 003)

**ON A/C 101-200,

(Ref. Fig. 004)

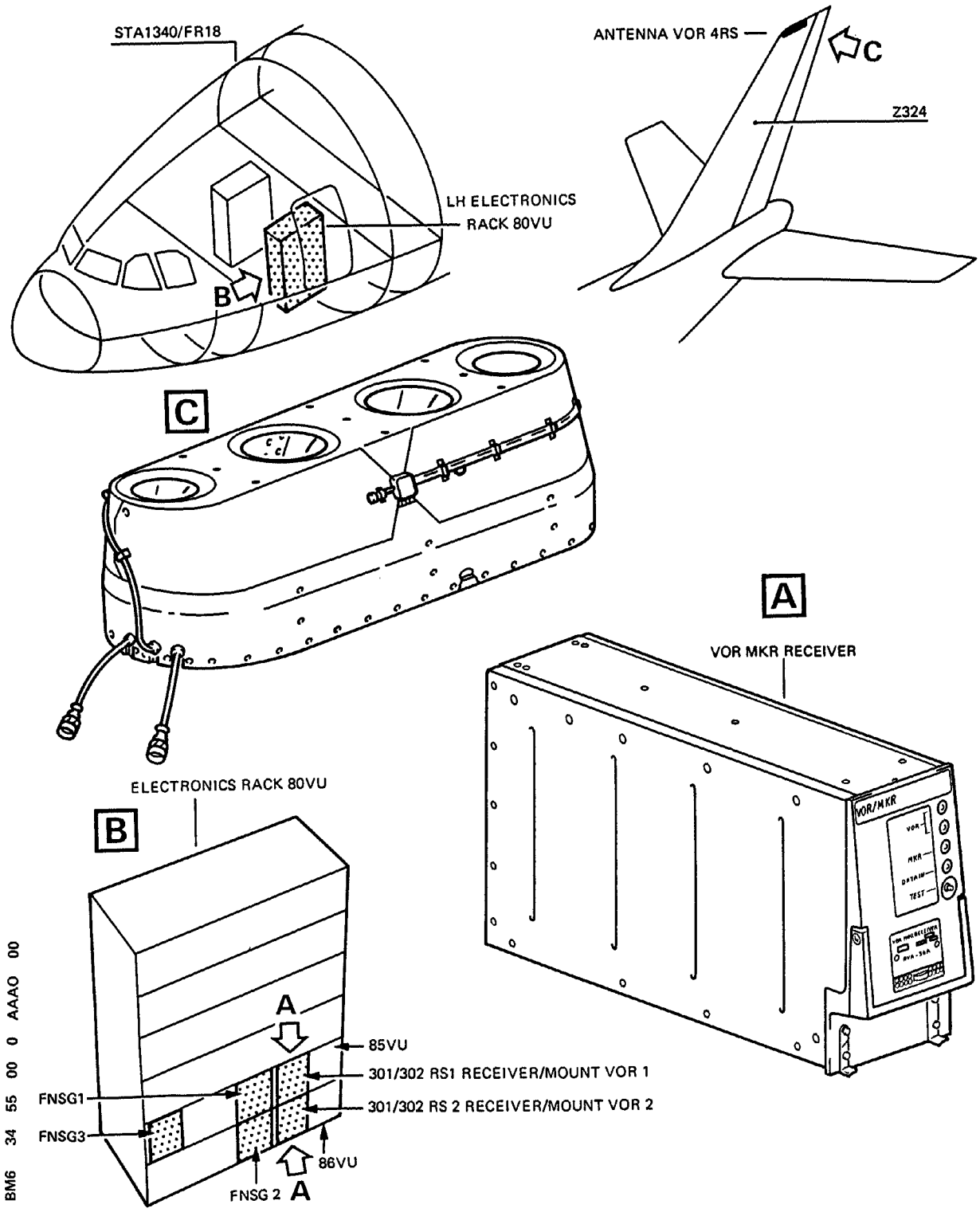
**ON A/C ALL

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
	VOR SYSTEM:				
301RS1	VOR/MKR RECEIVER 1	85VU	121		34-55-31
301RS2	VOR RECEIVER 2	86VU	121		34-55-31
3RS1	VOR/DME CONTROL UNIT 1	8VU	211		34-55-13
3RS2	VOR/DME CONTROL UNIT 2	8VU	212		34-55-13
4RS	VOR ANTENNA		324		34-55-11
5RS1	VOR/MKR 1 TEST BUTTON	470VU	222		
5RS2	VOR 2 TEST BUTTON	470VU	222		
	ASSOCIATED SYSTEM:				
10FN1	DDRMI 1	3VU	211		
10FN2	DDRMI 2	5VU	212		
28FN1	EFIS SGU 1	85VU	121		
28FN2	EFIS SGU 2	86VU	121		
28FN3	EFIS SGU 3	85VU	121		
33FN1	VOR/NAV/ILS SWITCH	413VU	211		

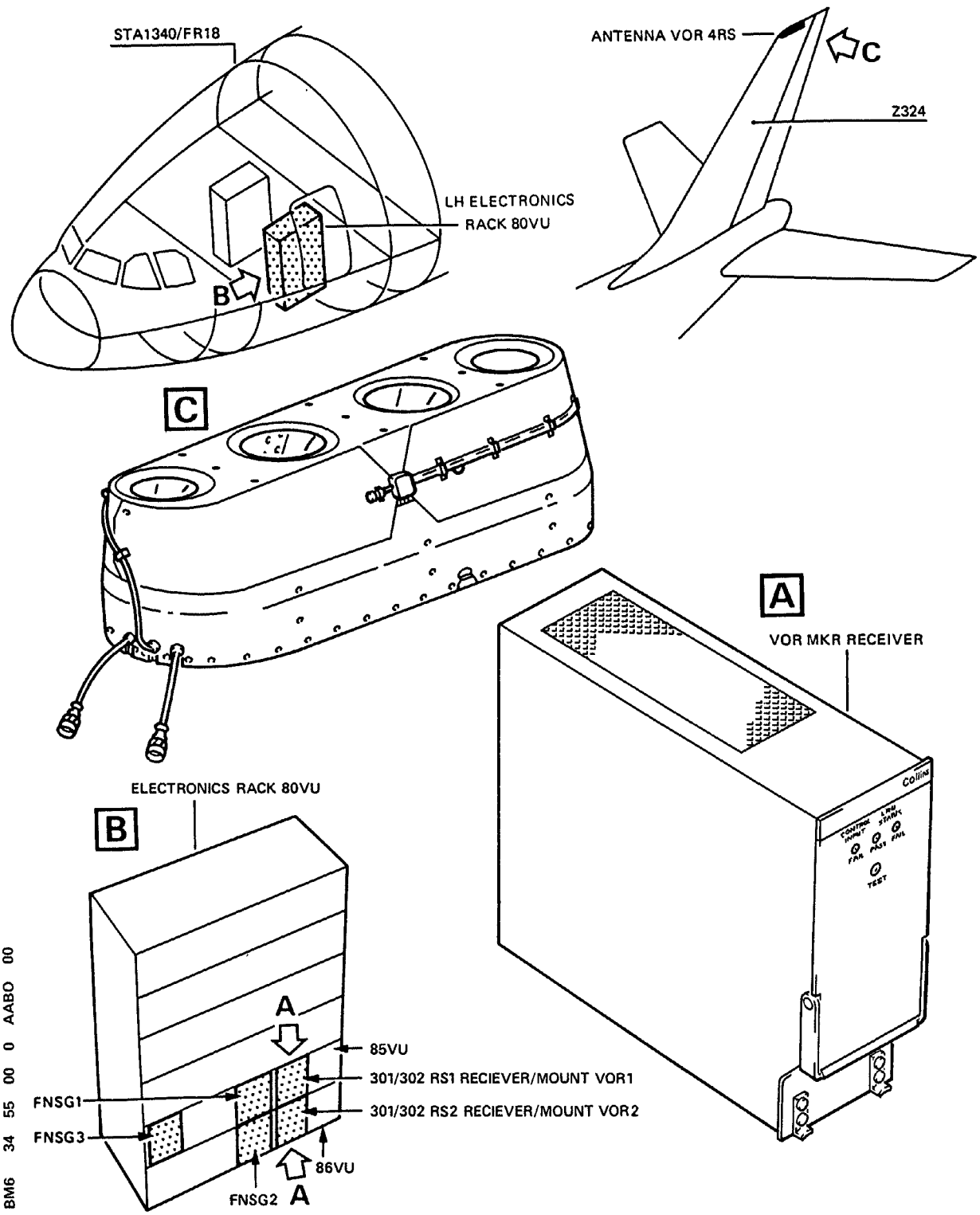
FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
33FN2	VOR/NAV/ILS SWITCH	412VU	212		
143GB	AIR/GROUND RELAY	83VU	121		
44GB	AIR/GROUND RELAY	104VU	121		

NOTE : For system components which are mentioned but not described in detail please refer to:

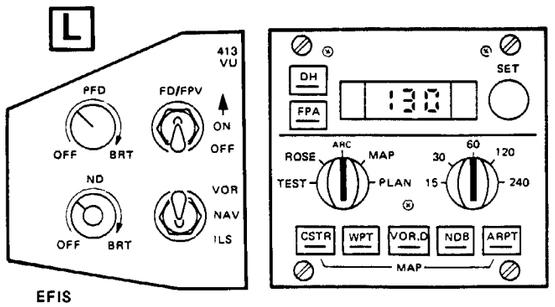
Audio Integrating Sys.	(Ref. 23-50-00)
AIDS	(Ref. 31-31-00)
Annunciator Lights	(Ref. 33-14-00 and 33-16-00)
FMS	(Ref. 34-60-00)
DDRMIs	(Ref. 34-29-00)
FCS	(Ref. 34-67-00)
EFIS, PFD, ND	(Ref. 34-70-00, 34-74-00, 34-75-00)



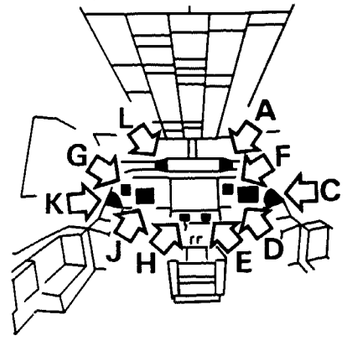
VOR - Component Location - Electronics Compartment
Figure 001



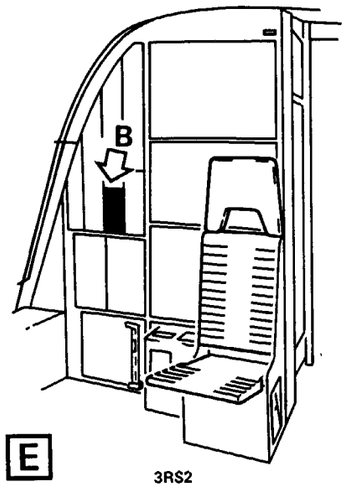
VOR - Component Location - Electronics Compartment
Figure 002



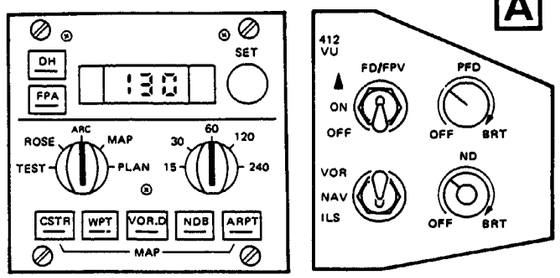
EFIS COMPLEMENTARY CONTROL PANEL



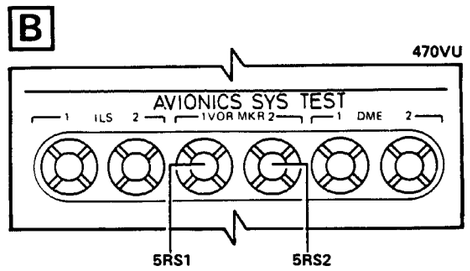
EFIS CONTROL PANEL (CAPT)

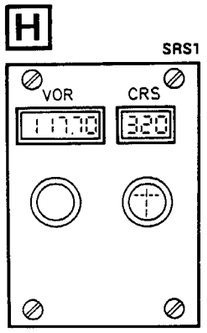


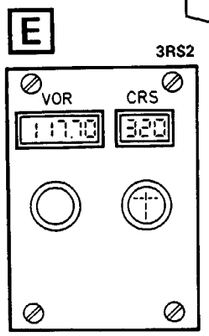
EFIS CONTROL PANEL (F/O)



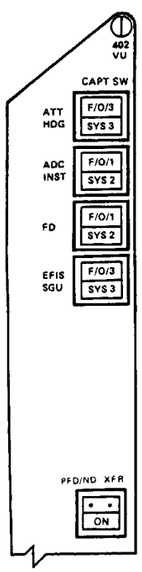
EFIS COMPLEMENTARY CONTROL PANEL



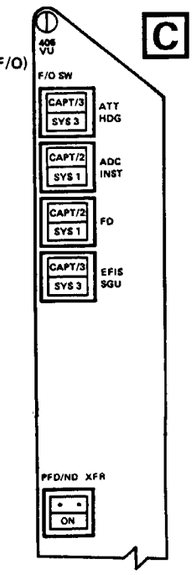


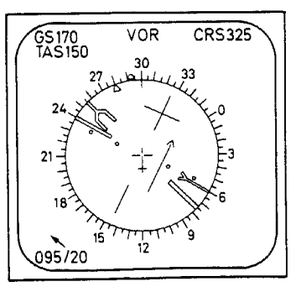


EFIS SWITCHING PANEL (CAPT) K

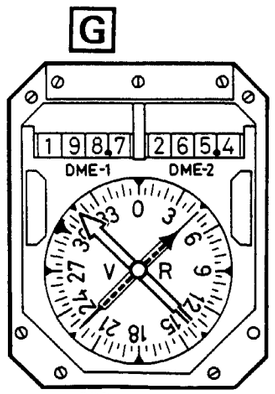


EFIS SWITCHING PANEL (F/O) C

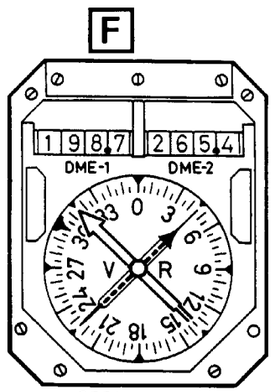




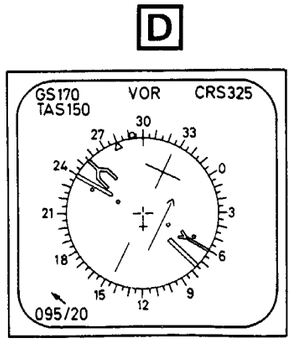
ND (CAPT)



DDRMI (CAPT) 10FN1



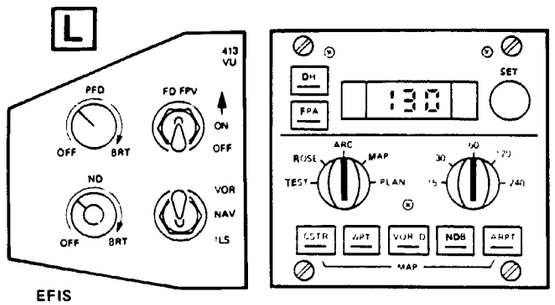
DDRMI (F/O) 10FN2



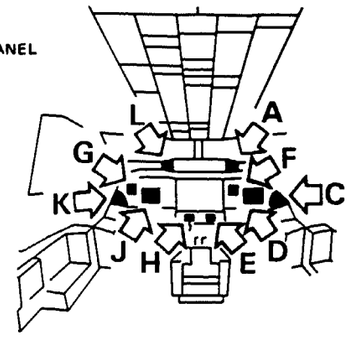
ND (F/O)

BM6 34 55 00 0 ACHO 01

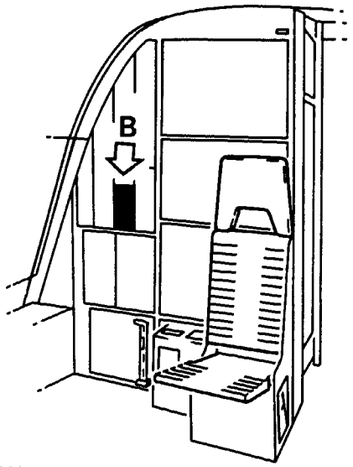
VOR - Component Location - Flight Compartment
Figure 003



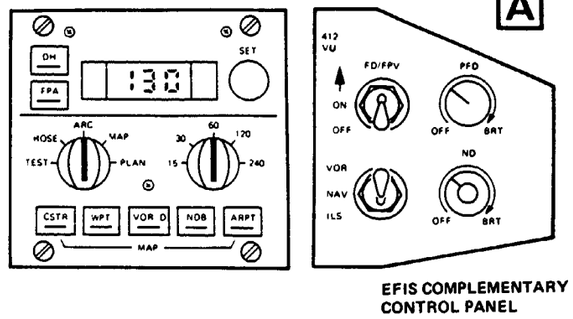
EFIS COMPLEMENTARY CONTROL PANEL



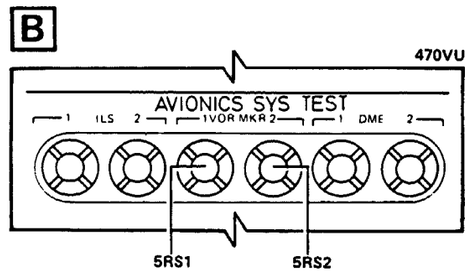
EFIS CONTROL PANEL (CAPT)

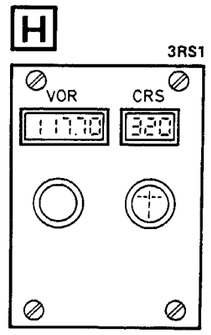


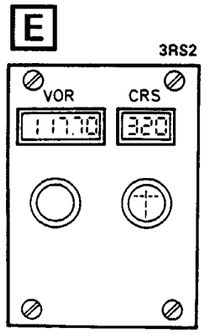
EFIS CONTROL PANEL (F/O)



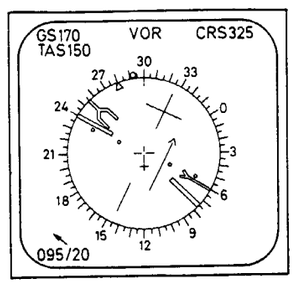
EFIS COMPLEMENTARY CONTROL PANEL



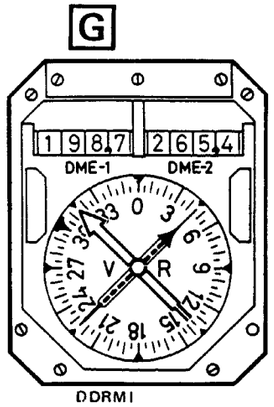




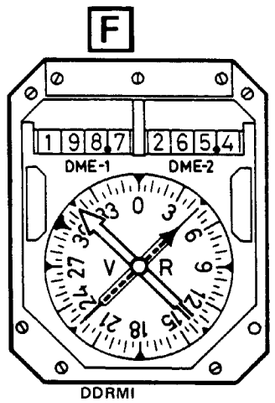
EFIS SWITCHING PANEL (CAPT) K



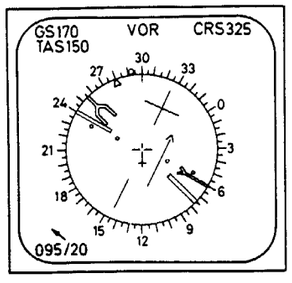
ND (CAPT)



DDRMI (CAPT) 10FN1

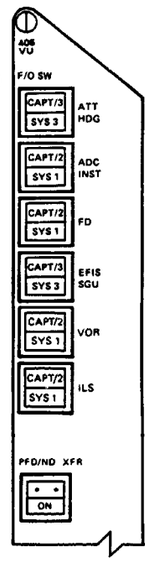


DDRMI (F/O) 10FN2



ND (F/O)

C EFIS SWITCHING PANEL (F/O)



BM6 34 55 00 0 ACKO 01

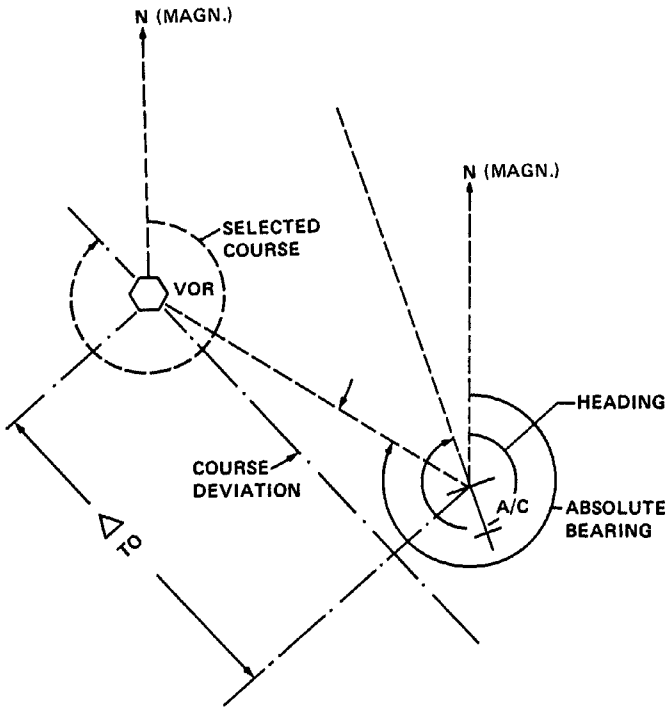
VOR - Component Location - Flight Compartment
Figure 004

3. System Description

A. Principle (Ref. Fig. 005, 006)
The principle of VOR navigation is phase comparison in the VOR receiver, between a reference phase and a variable phase signal, both generated by the ground station. Furthermore, the ground station provides a morse identification and sometimes transmission of voice information.
The VOR frequencies are placed in the band from 108 MHz to 117.95 MHz with 50 kHz spacing. Some of the frequencies in this band are ILS/LOC frequencies. If one of these frequencies is selected on the control unit no VOR station will be tuned.
Two frequencies 30 Hz AM and 30 Hz FM on the carrier are used for the angular detection. Their phase differences represent the angle which is given between the line from ground station to aircraft and magnetic north. This angle is detected directly by the VOR receiver.
NOTE : To this bearing signal, a heading signal from IRS is added to get a relative bearing signal for indication in DDRMIs. Further, a selected course signal is added to the bearing. The result enables a calculation of a course deviation and a TO/FROM signal. These signals are converted to be shown on the NDs.

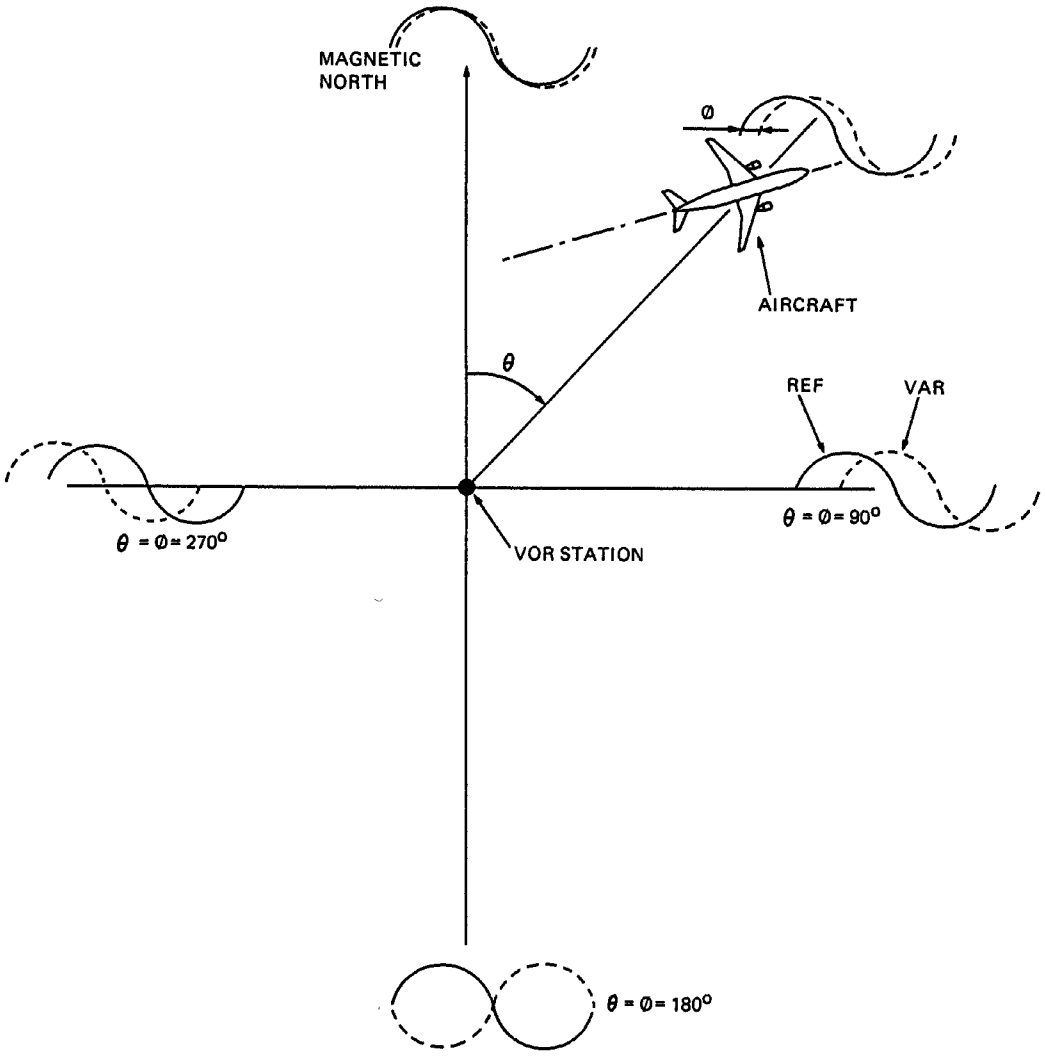
B. System Architecture
The aircraft is equipped with two independent VOR systems which can be used simultaneously.
In each system the VOR receiver is connected to :
- the common VOR Antenna
- the VOR/DME Control Unit
- the DDRMIs (one each for CAPT and F/O)
- the Audio Integrating System
- The AVIONICS SYS TEST Panel
- the EFIS (SGUs)
- the FCC System
- the FMS
- the AIDS
- AIR GROUND (Relay) Switch
- VOR/NAV/ILS Switch

The control unit provides digital frequency and course data. These digital signals contain serial BCD and BNR data to tune the receiver and calculate deviation and TO/FROM information in the EFIS SGUs.
The VOR/MKR receiver can also be tuned by the FMC.
The FMC tunes the VOR frequency if the VOR/NAV/ILS switch is in NAV or ILS position.
The VOR/NAV/ILS switch also gives information for Autopilot through FCC whether the aircraft is in VOR or in ILS mode.
The receiver output is connected to the DDRMIs, the EFIS SGUs, the FMC and the FCC. The EFIS SGUs are connected to the displays (PFDs, NDs).
The Captains's displays are driven by EFIS SGU 1 (or EFIS SGU 3 in case of failure) and the F/O displays by EFIS SGU 2 (or EFIS SGU 3 in case of failure).
The AIR/GROUND relay switch gives information relating to the landing/ takeoff of the aircraft to the VOR receiver, which is used for maintenance



BM6 34 55 00 0 AEAO 00

VOR - System Principle
Figure 005



BM6 34 55 00 0 AFAO 00

VOR - Principle of Phase Comparison
Figure 006

purposes. The audio output supplies the audio integrating system with the related VOR morse identification signal and sometimes voice information from the ground station. This signal can be heard in the headphones and loudspeakers, if the VOR/NAV/ILS switch is in VOR position.
The test circuit activates both VOR and MKR BITE to produce common outputs which are for VOR: Indication on DDRMIs, NDs.

**ON A/C 001-100,

(Ref. Fig. 007)

**ON A/C 101-200,

(Ref. Fig. 008)

**ON A/C ALL

C. Power Supply (Ref. Fig. 009)
The VOR systems are supplied with 115 V, 400 Hz.
- VOR/MKR 1 receiver and VOR/DME control unit 1 are powered from emergency bus 402XP via a 3 A circuit breaker 6RS 1.
- VOR 2 receiver and VOR/DME control unit 2 are powered from normal bus 205XP via a 3 A circuit breaker 6RS 2.
- DDRMI 1 is supplied by the emergency bus 401XP via a 3 A circuit breaker 11FN 1.
- DDRMI 2 is supplied by the normal bus 205XP via a 3 A circuit breaker 11FN 2.

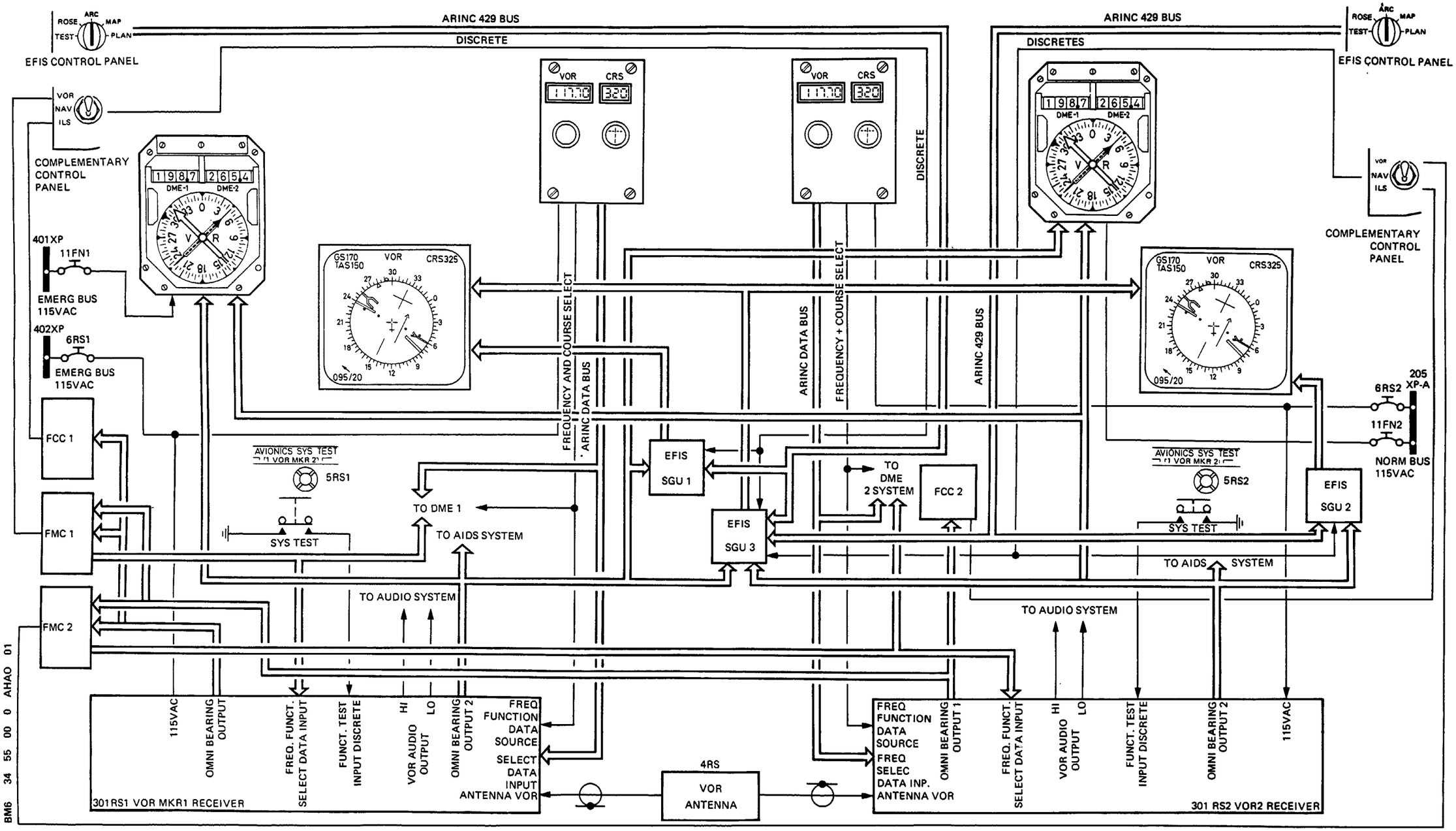
(Ref. Fig. 009)

**ON A/C 001-100,

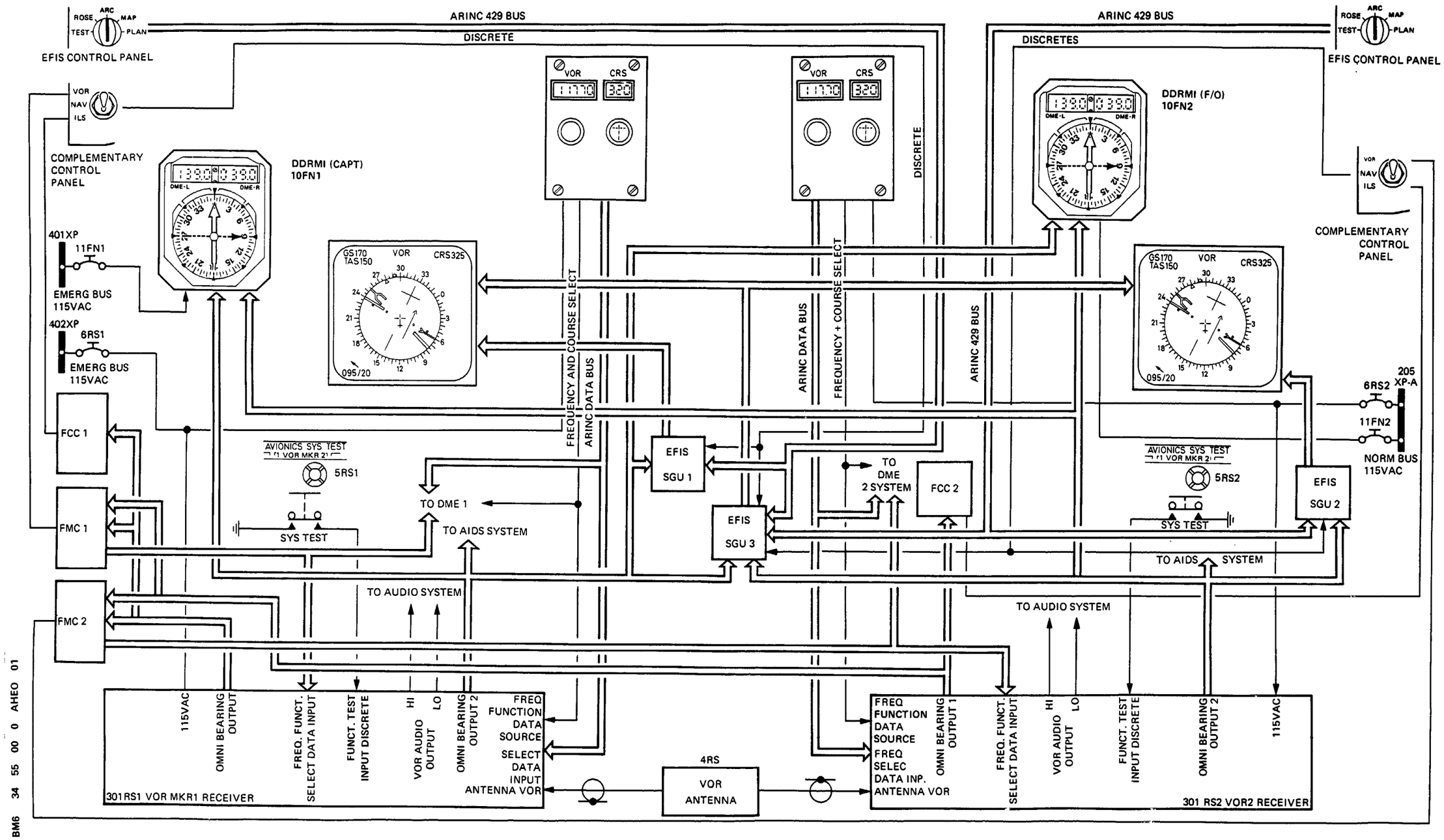
4. Component Description

A. VOR Receiver
(1)Description (Ref. Fig. 010)
The front panel of the receiver features the following indications:
- VOR (red), indicates a failure in the internal circuit of the receiver.
- VOR (green), indicates the correct functioning of the receiver.
- MKR (red), indicates the status of the MKR receiver.
- DATA IN (red), indicates the bit status of the input signal to the receiver.

There is also a TEST button to initiate the VOR/MKR function test.
The VOR receiver consists of the following modules :
RF receiver, digital synthesizer. VCO, VOR baseband processor. CPU, BITE and audio amplifier. Data interface and power supply and a fault memory module.

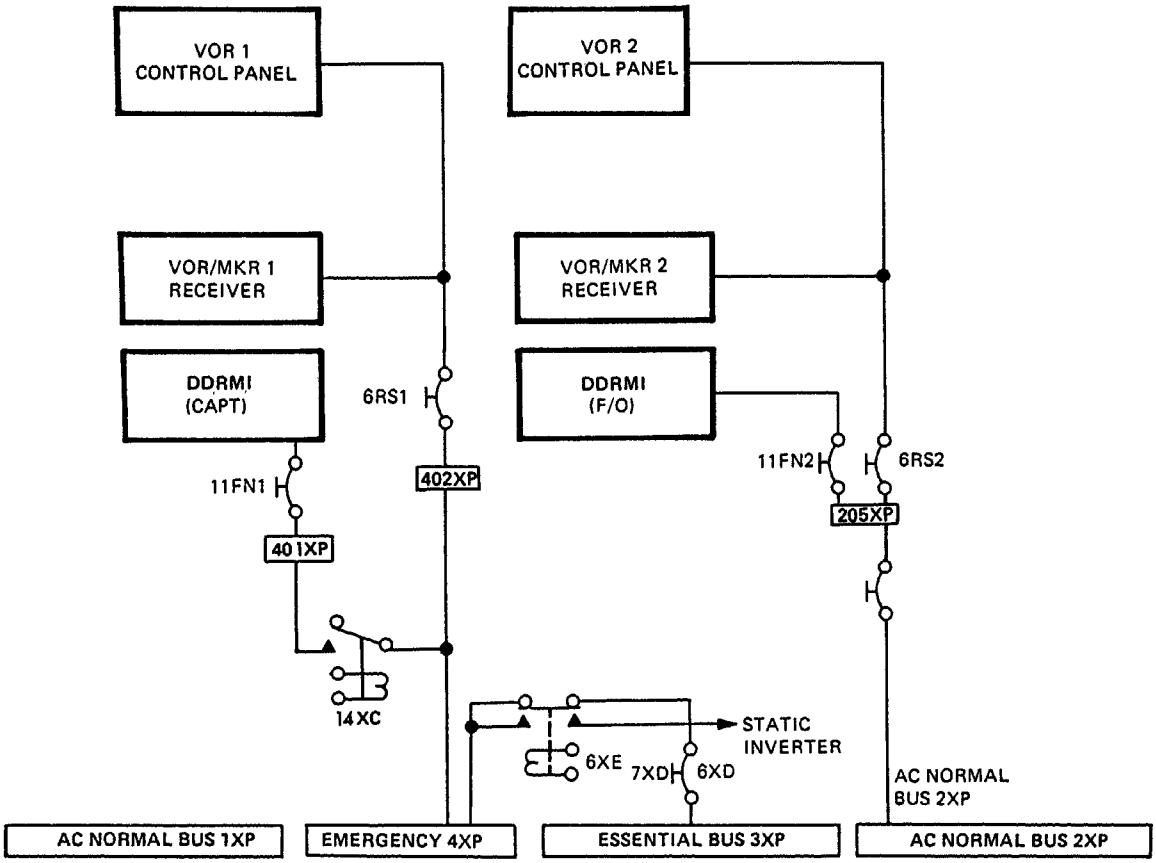


VOR Schematic Diagram
Figure 007



BM6 34 55 00 0 AHEO 01

VOR Schematic Diagram
Figure 008



BM6 34 55 00 0 ALAO 00

VOR - Power Supply
Figure 009

**ON A/C 101-200,

4. Component Description

A. VOR Receiver

(1)Description (Ref. Fig. 011)

The front panel of the receiver features the following indications:

- CONTROL INPUT FAIL (red), indicates that no information is received at the input ports.
- LRU STATUS PASS (green), indicates that no faults are detected during self-test sequence.
- LRU STATUS FAIL (red), indicates that a fault is detected during self-test sequence.

There is also a TEST button to initiate the VOR/MKR function test.
The VOR receiver comprises the following modules:
RF receiver, FM demodulator, I/O interface, processor, preprocessor, power-supply, systhesizer and test-oscillator.

**ON A/C 001-100,

(Ref. Fig. 010)

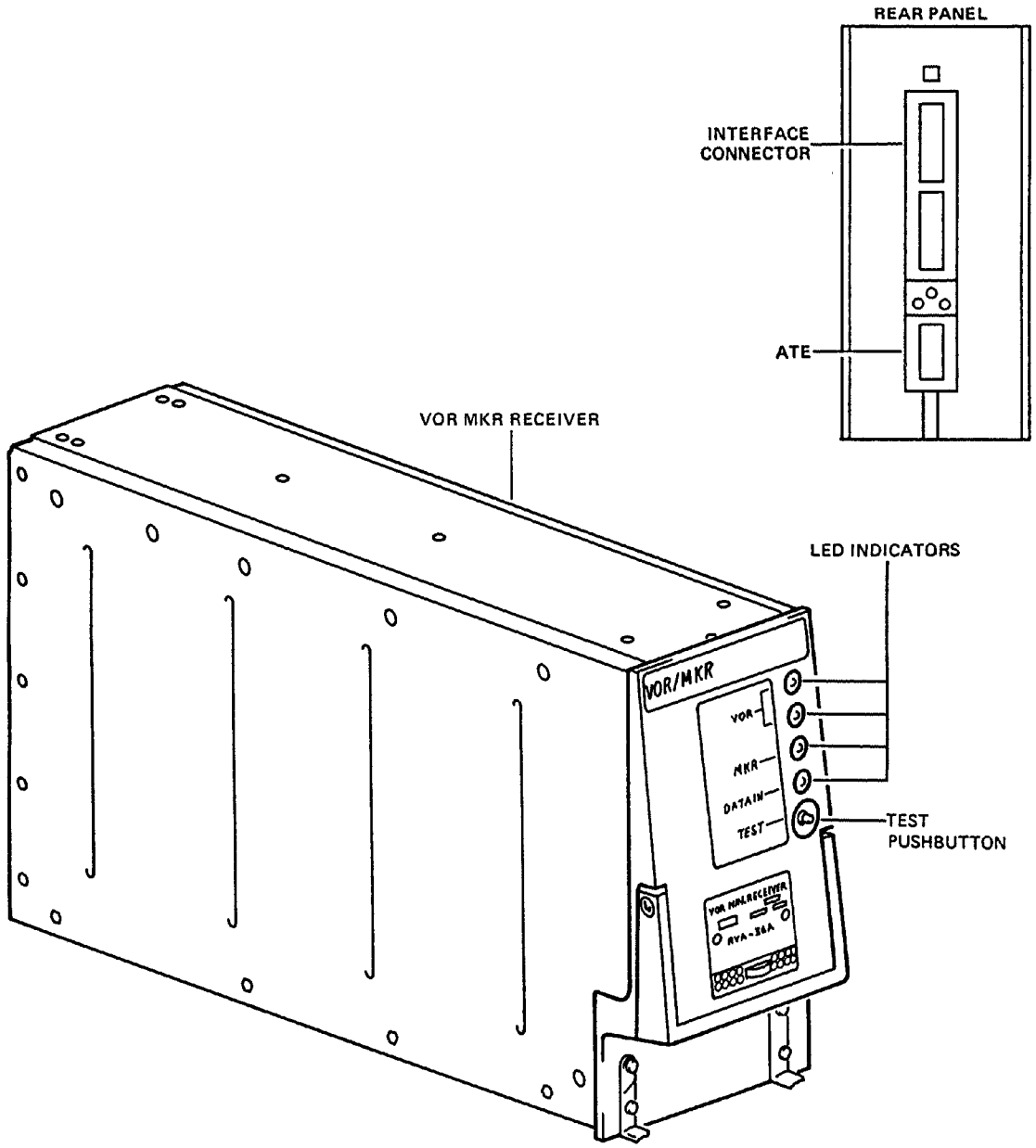
**ON A/C 101-200,

(Ref. Fig. 011)

**ON A/C 001-100,

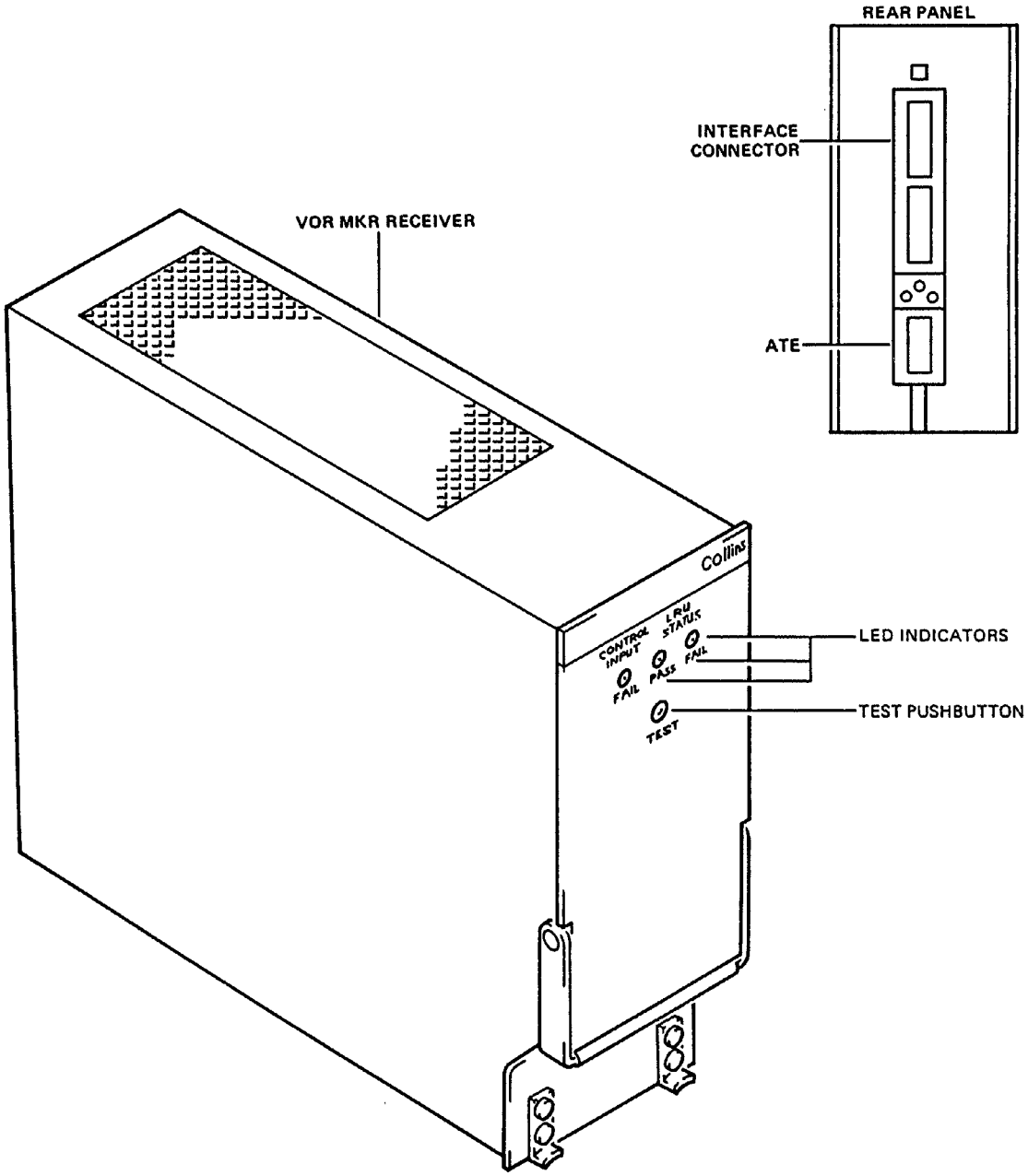
(2)Operation (Ref. Fig. 012)

The transmitted ground station signal is applied to a RF receiver via the antenna. In the RF receiver, the signal is passed through a preselector to a mixer where it is combined with the VCO injection signal to produce an 18.1 MHz IF.
After amplification the IF signal is fed to a detector, where the modulation is recovered from the IF signal to produce the NAV composite output. This output is applied to the BITE and audio amplifier module, where it is used for the switching selector and applied to an audio filter. The audio filter passes audio frequencies between 350 Hz and 2,500 Hz and rejects other outputs. A positive and negative noise limiter eliminates all noise spikes. The output of limiter is fed through a potentiometer to the audio amplifier and then to the aircraft audio integrating system.
The switching selector routes the NAV composite output in two directions, to the 30 Hz variable bandpass filter and to the 9,960 Hz bandpass filter on the VOR baseband processor.
In the first direction, all frequencies other than 30 Hz are rejected. A signal conditioner converts the 30 Hz variable-phase sine wave into a 30 Hz square wave and then divides the frequency to produce a 15 Hz square wave. The 15 Hz square wave is fed to the phase comparator. In



BM6 34 55 00 0 AMAO 00

VOR - Receiver
Figure 010



BM6 34 55 00 0 AMBO 00

VOR - Receiver
Figure 011

the second direction, the 30 Hz variable phase component of the NAV composite signal is rejected and the 9,960 Hz component is passed through the filter to the limiter. The 9,960 Hz is then applied to a phase locked loop FM demodulator that recovers the 30 Hz reference signal. A signal conditioner converts this 30 Hz reference-phase sine wave signal into a 30 Hz square wave and divides the frequency to produce a 15 Hz square wave. The 15 Hz square wave is fed to the phase comparator. Phase comparator accepts the 15 Hz reference period and variable phase inputs and compares the phase relationship between the two signals. When the two signals are in phase (VOR bearing is zero degree), the comparator output is a symmetrical signal.
Its pulse width varies directly with the phase difference (VOR bearing) of the two input 15 Hz signals.
The data interface recognizes and converts VOR frequency serial inputs on the ARINC 429 data bus into parallel data for CPU. It also accepts the 32 bit VOR omnibearing data word from the CPU and transmits this information on bearing outputs 429 data bus for application to DDRMI and EFIS. The CPU module consists of a microprocessor, RAM, ROM, timer and control logic. The microprocessor performs numerous tasks contained in the program which is stored in ROM. The control logic controls the destination of data output of the microprocessor. The timer measures and stores the time of the VOR PHASE GATE and VOR PERIOD GATE from the phase comparator in the VOR baseband processor. At the appropriate time, this information is sent to the microprocessor which calculates the omnibearing to the VOR station from this data. The power supply module contains a 5 V monitor circuit which monitors 5V DC power supply for CPU operation, if a power supply failure occurs, the 5 V monitor holds the CPU in the reset state until the fault is removed.
The fault memory module uses a nonvolatile EAROM to store any faults that were detected during a flight segment. Maximum 13 faults can be stored for any flight segment.
The flight segment, beginning and end is derived via air/ground relay from the undercarriage strut switch. If a fault exists continuously, it is only stored once. If it exists intermittently, it is stored each time it occurs.
If two similar faults are stored in memory, the red LED on the front panel of the receiver will light when TEST button is pressed.
The contents of the nonvolatile memory can be read by access to ATE connector on the receiver. Fault memory is cleared by landing gear squat switch during take-off of the next flight.

(3)Monitoring

A monitoring system allows the detection of performance degradation and sets the status bits for the VOR bearing message.
The monitor operations are performed under microprocessor control.
They consist of :

- monitoring the phase locking at the synthesizer
- checking the AGC voltage level and AGC error detector
- monitoring the VCO drive level
- monitoring the NAV composite signal level
- monitoring the power supply
- checking if data is delivered from the control unit.

When any failure is detected the monitoring system sets the ''failure warning'' code to be delivered to the respective displays.
In addition, the failure information is stored in the internal nonvolatile memory for maintenance purpose.
NOTE : The VOR 1 system and in many cases the VOR 2 system are connected to the AIDS via ARINC data buses. This allows the use of AIDS facilities to support VOR maintenance activities.

**ON A/C 101-200,

(2)Operation (Ref. Fig. 013)

- In the VOR RF receiver the signal is passed through the first RF preselector to the high gain RF amplifier and further to the second preselector. The first preselector and RF amplifier are AGC controlled to provide maximum gain with low signal input, the second preselector is tuned with a DC voltage ranged from 5V to 14V depending on the selected VOR frequency.
  The signal is then applied to a mixer that mixes the incoming modulated RF frequency with the synthesizer injection frequency which is 21.4 MHz below the incoming RF frequency. A second mixer injection source applies a 21.5685 MHz signal to the second mixing in the RF receiver, the modulated IF signal as result is then amplified and fed to an envelope detector. The detector detects the modulation peaks from the IF subcarrier. A crystal filter provides the selectivity of the receiver.
- The FM demodulator receives the composite detected VOR signal from RF receiver. This signal enters through an operational amplifier and is broken down three ways. One leg of the signal is the 30 Hz AM signal that is fed directly to the preprocessor. The second leg provides the voice/ident audio signal, and the third leg provides the 30 Hz FM signal. 1000 Hz prefilter and amplifiers separate the 1020 Hz audio signal, which is buffered and amplified by an operational amplifier. Two transistors drive a matching transformer that couples the ident signal to the aircraft audio integrating system. Short circuit protection is incorporated by feed back loop from the transformer output to the input of operational amplifier.
  The FM demodulator removes the 30 Hz FM signal from the FM subcarrier. The 30 Hz FM is sent to the preprocessor where it is multiplexed with the 30 Hz AM signals. The FM demodulator also generates the VOR functional self test audio signal.
- When the receiver is in self test, a 300 kHz signal input to the FM demodulator is reduced to a 30 kHz clock signal by a four bit binary counter. The 30 kHz then clocks the 12 bit binary counter, whose output addresses 2 K x 8 PROM. The PROM output generates the digital form of the VOR audio test signal, and is converted to a composite analog signal containing the 9960 Hz FM, 30 Hz audio and 1020 Hz audio signals. The composite test signal is amplified and applied to the VOR self test oscillator and the preprocessor to test the individual stages. The functional self test is initiated by either the functional test code on the tuning word, the ARINC discrete self-test input or the front panel push to test button.

- The I/O Interface consists of the ternary bus receivers, ternary bus drivers, RAM, UART and microprocessor.
  Selected VOR frequency and control function information are sent in a serial 32 bit word. The frequency function control words are accepted by either ternary A or B input ports, with B input as complement of A input. Each control word input is applied to a set of differential operational amplifiers that converts each positive going ternary pulse to a TTL level pulse. Each pulse represents a logic level one in the incoming word. The op amp also produces a pulse for every logic zero present in the incoming serial word. These pulse trains of ones and zeros are applied to a multiplexer which acts as a switch to select one of the two frequency input ports and then fed to the UART. The UART receives data in serial form on two lines and converts the 32 bit words into four 8 bit bytes that can then be handled by the microprocessor. The microprocessor uses the frequency information from the input word to produce the 2 out of 5 code used to tune the VOR receiver. The microprocessor receives control discretes such as Front Panel Test, Functional Test etc., which is used to configure the VOR output deviation word. It generates self test discretes that are sent to the front panel annunciators and the rear ATE connector.
- The VOR deviation word is an ARINC 429 - 32 bit serial ternary word. The first eight bits identify the word to the aircraft bus system as a VOR output with an octal label of 222. The next two bits perform the SDI. The next three bits are encoded to represent Marker Beacon, the next three bits are pad bits and always at a logic zero. The data field bits, 18 through 28, represents the omnibearing angles from 0 deg. to 180 deg. The sign/status matrix consists of bits 29, 30, 31. Bit 29 is the sign bit, a logic one in this position indicates the bearing angle in the data field is from 180 deg. to 360 deg. A logic zero indicates the bearing from 0 deg. to 180 deg. Bits 30 and 31 indicate the status of the receiver such as Functional Test, No Computed Data, Failure Warning. The last bit is the parity bit.
- The VOR synthesizer provides an output frequency for injection into the first mixer of VOR RF receiver and tuning voltage for the voltage variable capacitor in the preselectors.
- The detected 30 Hz VOR signals applied to the preprocessor are band limited and time multiplexed in preparation for digitizing by instrumentation processor. The preprocessor supplies the sampling frequencies and the analog digital clock frequency for the processor.
- The Processor module consists of a microprocessor, RAM, ROM, an analog to digital converter, master reset circuit and digital buffers. The processor receives the multiplexed analog 30 Hz signals from the preprocessor. The analog digital converter converts the multiplexed signals into parallel 12 bit digital words. These are then applied to a set of buffers that isolate the converter from the other data bus operations. Incoming data and intermittent calculations done by the microprocessor are stored in RAM. Master reset is activated during power up of the unit. If the processor fails to operate, a master reset signal in generated.
- The Power Supply module converts 115 V AC, 400 Hz input power into the required voltages of 5 V DC REF, 5 V DC TTL, 12 V DC, -12 V DC,

20 V DC, -28 V DC and 26 V DC unregulated.
The power supply uses linear regulator and a pulse width modulated step down regulator to prevent aircraft power interruptions from shutting down the receiver. Overvoltage protection is provided.

(3)Monitoring
A monitoring system allows the detection of performance degradation and sets the status bits for the VOR bearing message.
The monitor operations are performed under microprocessor control.
They consist of:
- monitoring the VOR lock output (the locking for the synthesizer)
- checking for valid input words
- checking if there is data delivered from the control unit (decodes the binary frequency into a 2 out of 5 code)
- monitoring of presence and level of the audio components of the VOR signal

When any failure is detected the monitoring system sets the ''failure warning'' code to be delivered to the respective displays.
In addition, the failure information is stored in the internal nonvolatile memory for maintenance purpose.
NOTE : The VOR 1 system and in many cases the VOR 2 system are connected to the AIDS via ARINC data buses. This allows the use of AIDS facilities to support VOR maintenance activities.

**ON A/C 001-100,

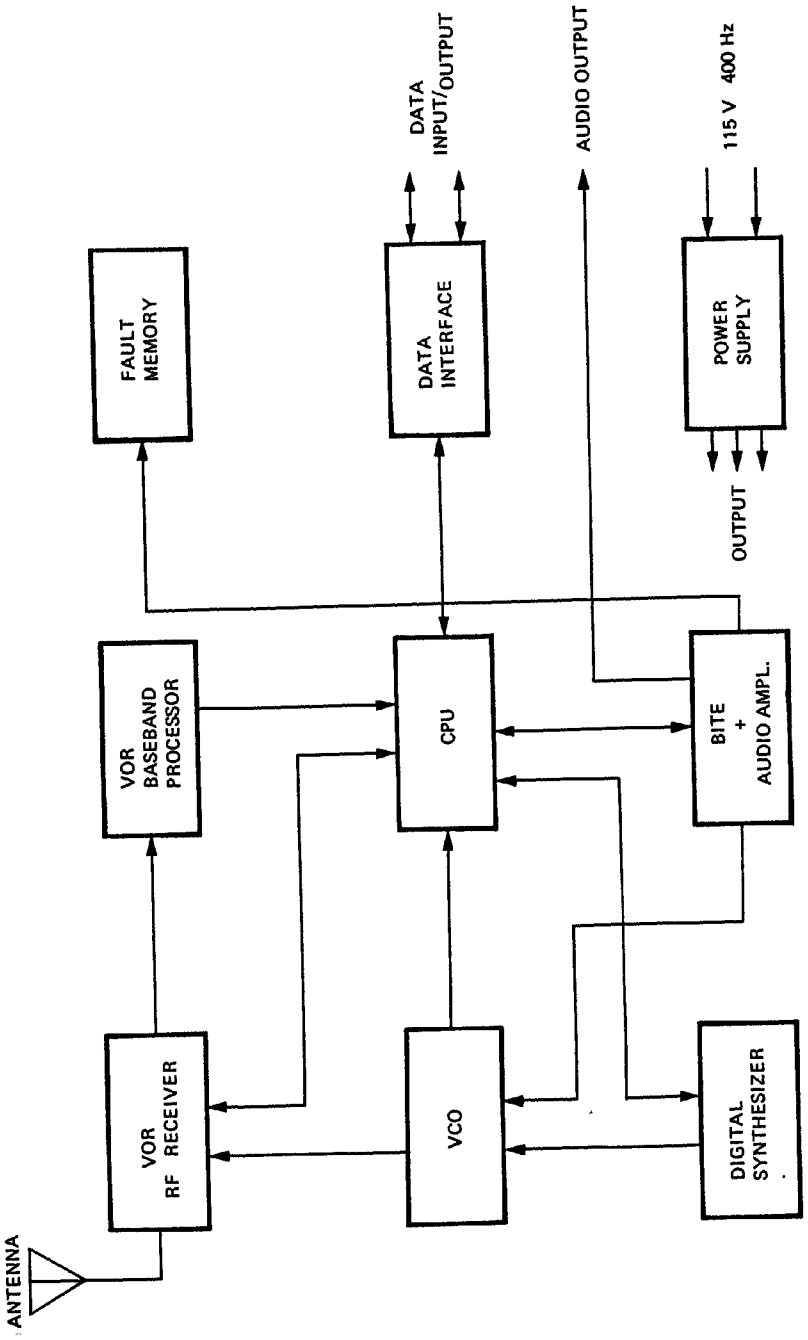
(Ref. Fig. 012)

**ON A/C 101-200,

(Ref. Fig. 013)

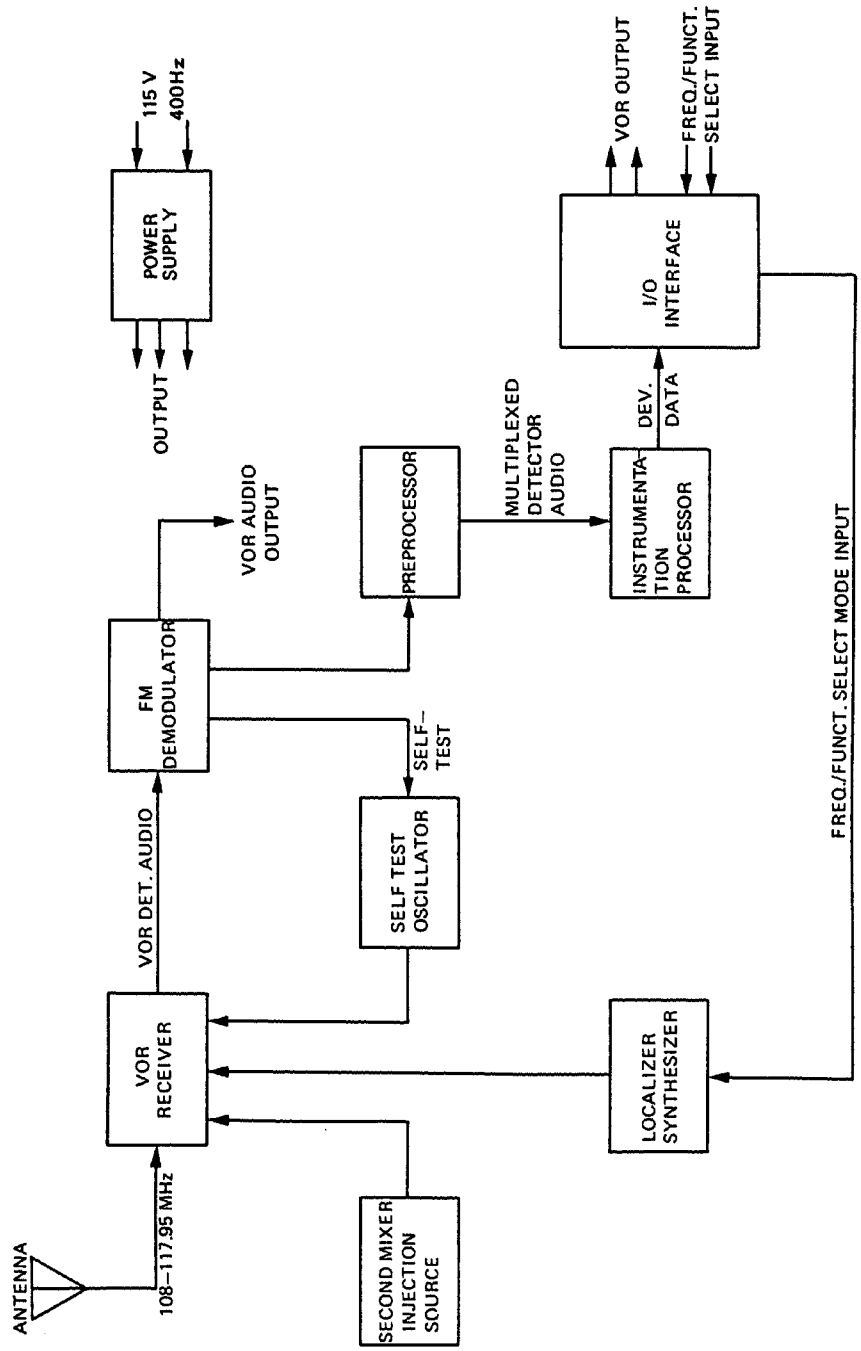
**ON A/C ALL

B. VOR/DME Control Unit
(1)Description (Ref. Fig. 014, 015)
The dual purpose control panel, used by the VOR system and the DME system, enables the selection of VOR and DME ground stations and the tuning of the VOR receiver and the DME interrogator. DME channels are paired with VOR and ILS frequencies.
The front panel of the control unit features:
- a VOR window in which the corresponding VOR or ILS paired frequency is displayed in steps of 50 kHz,
- a frequency control selector with inner and outer concentric knobs. The inner knob controls the fractions of MHz and the outer knob controls the tens and units of MHz,
- a CRS window in which the selected course is displayed in steps of 1°,
- a course control selector which enables the selection of course



BM6 34 55 00 0 APAO 00

VOR - Receiver Block Diagram
Figure 012



BM6 34 55 00 0 APBO 00

VOR - Receiver Block Diagram
Figure 013

from 0° to 360°,
- a 180° shift pushbutton in the centre of the course control selector.

The displays use LCD indicators associated to opto-electronic incremental encoders which are driven by the control knobs. The stable positions of the encoders are locked by a mechanical pawl. The control unit is illuminated by the 5 V instrument panel integral lighting system (Ref. 33-13-00).

(2)Operation

The incremental encoders are made up of an opto-electronic assembly designed to impose logic states on its output wires according to its position.

The dotted vertical lines represent the stable reading positions. If the stable position 1 is taken as reference zero, wires A and B are at state 00. If the knob is turned in the direction of the arrow, the following states are obtained:

Wire A	Wire B	
0	0	state 1
1	0	
1	1	
0	1	

If the knob is turned in the reverse direction (decrementation) the following states are obtained:

Wire A	Wire B	
0	0	state 1
0	1	
1	1	
1	0	

Reading the successive states of the wires A and B indicates the direction of rotation of the knobs and the number of steps.

The processing unit periodically scans the outputs of the incrementel encoders to define their states. If the course knob is incremented, the processing unit detects the change of state and the course value previously stored is updated.

A message is calculated according to the data stored in the memory of the processing unit.

Once the message is organized, it is fed to the logic ARINC transmitter which transmits the ARINC compatible message to the ARINC receiver.

The processing unit reads the received word and compares it to the transmitted word. If they are not identical, a FLAG signal is sent to the display to block the ARINC transmitter. If they are identical, the value received through the ARINC receiver is displayed and the ARINC transmitter is enabled. Transmission on the ARINC line is then performed.

There are four codes for course and frequency messages, these comply with ARINC 429, and are sent to the bus:
- Label 034, VOR frequency,
- Label 035, DME frequency,
- Label 024, BCD course,

- Label 100, BNR course,

C. Antenna (Ref. Fig. 016)
The loop-type omnidirectional antenna is horizontally polarized, has an impedance of 50 Ohm and a maximum VSWR of 2.5 : 1 when both systems are connected.
It consists of aluminum elements mounted on a fibreglass shell. The aluminum elements are bonded through a coupler.
The antenna is fitted on the tip of the vertical stabilizer and is capable of receiving signals in the frequency range of 108 MHz to 118 MHz.

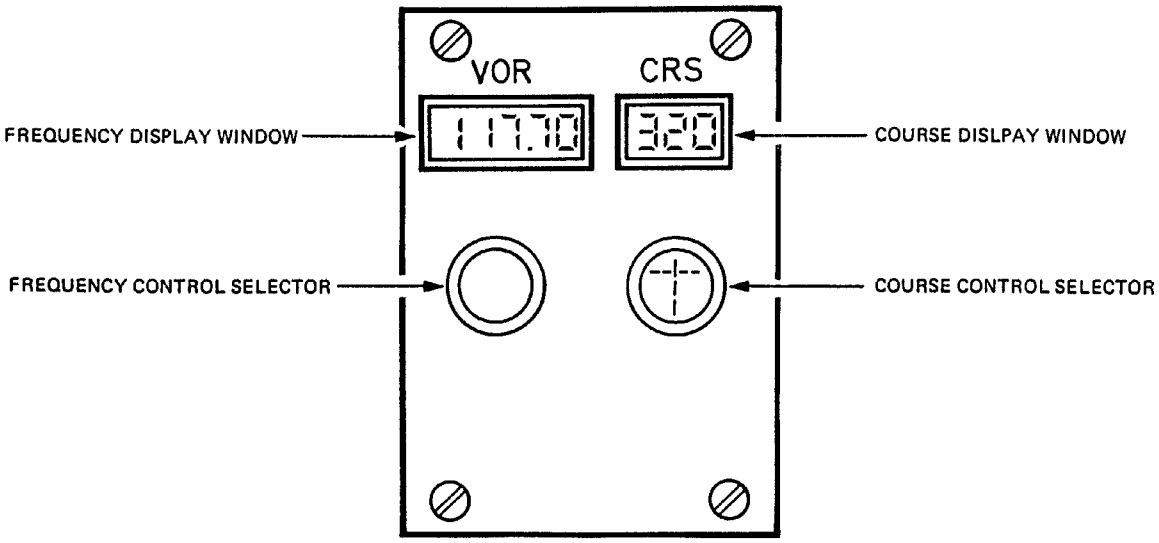
5. System Operation

A. Energization
The VOR receiver is energized when the bus bars are supplied and the VOR/MKR 1 or VOR 2 circuit breaker is pressed.
For the VOR operation, all related components such as DDRMIs.
EFIS SGUs, PFDs, NDs etc., must also be energized.

B. Control
- Frequency Selection
The VOR frequencies can be selected by rotating the respective knob on the control unit.
- VOR/DME Frequency Display
The selected frequency is displayed by means of Liquid Crystal Devices.
- Course Selection
The VOR course can be selected by rotating the CRS selector knob. One rotation of the selector corresponds to 60° course variation. By pressing the selector button, the opposite course will be displayed (180° course reverse).
- Course Display
The selected course is displayed by means of Liquid Crystal Devices.
- VOR/NAV/ILS Switch:
By placing the switch in VOR position the VOR frequency is selected via the VOR/DME control unit. By placing the switch in NAV or ILS position, the FMC tunes the VOR frequency and in this case a dashed line appears on both windows of the control unit.
The selected frequency can be displayed if the respective page in FMC is called.

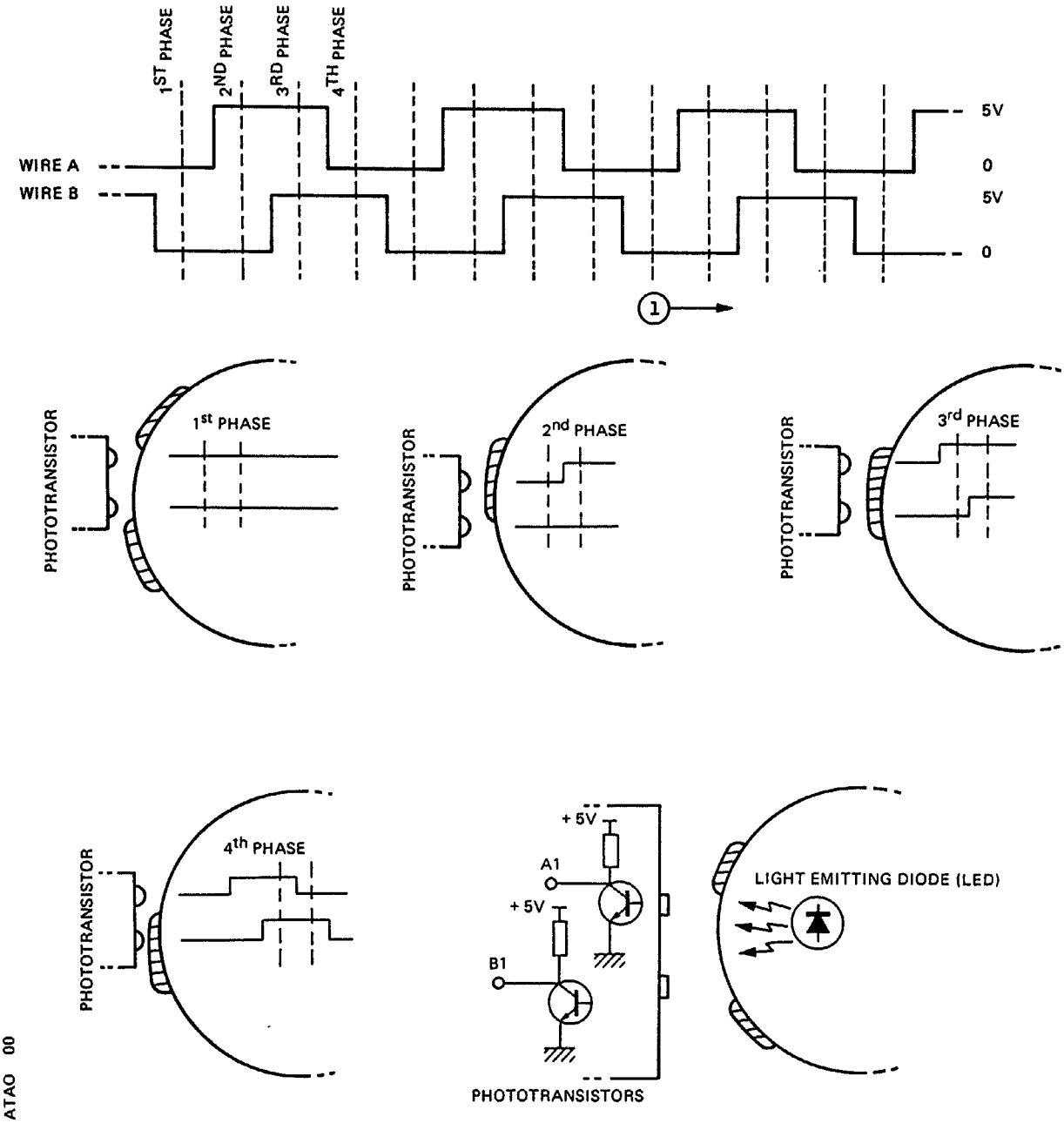
**ON A/C 001-100,

C. Indication
The indications of the VOR output data are as follows :
(1)In the DDRMIs:
Single pointers are associated with VOR 1 bearing information, double pointers are associated with VOR 2. In case of ''failure'' the referring VOR flag is present and the pointer is in 3 o'clock position. In case of ''NCD'' the referring pointer is in 3 o'clock position, no flag appears.



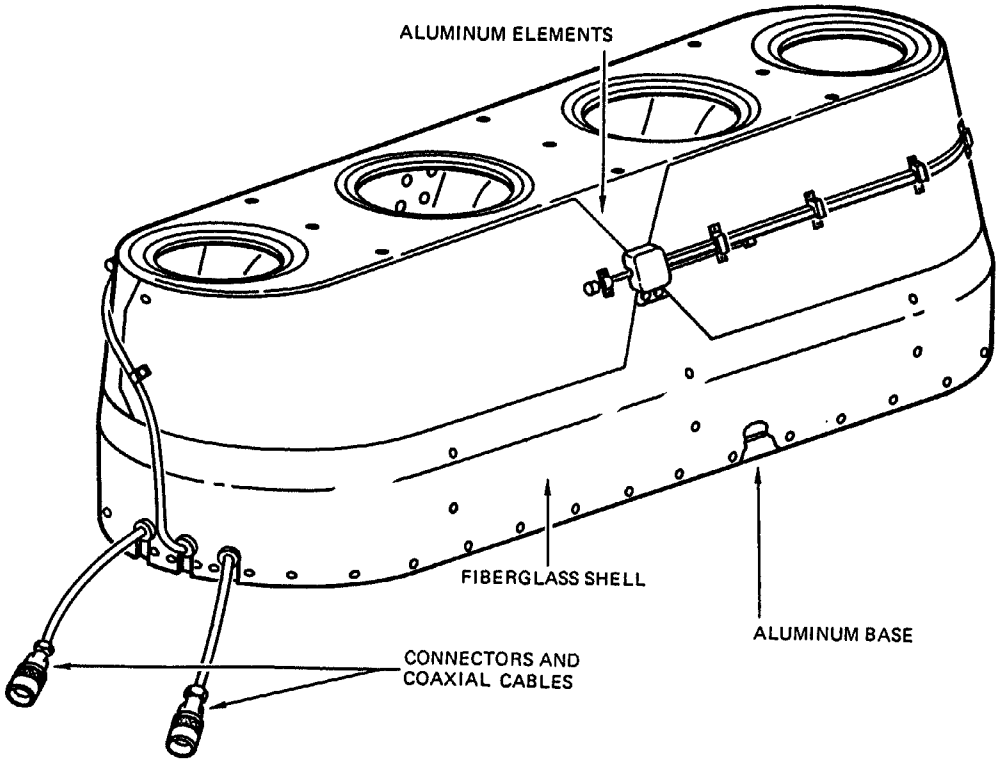
BM6 34 55 00 0 ARAO 00

VOR/DME - Control Unit Frontface
Figure 014



BM6 34 55 00 0 ATAO 00

VOR/DME - Control Unit Signal Generation
Figure 015



BM6 34 55 00 0 AVAO 00

VOR - Antenna
Figure 016

(2)In the navigation display (ND) :
VOR is mainly displayed in :
- ROSE mode : The VOR blue letter is displayed in the middle upper part of the display if ROSE mode is selected and the VOR/NAV/ILS switch is in the VOR position.
  The selected course is displayed as blue colored course pointer, the course value is displayed at the RH upper corner. The middle part of the course pointer is the lateral moveable deviation bar. The TO/FROM is indicated by a small arrow at the respective end of the deviation bar.
- ARC mode : The VOR blue letter is displayed in the middle upper part of the display when ARC mode is selected and the VOR/NAV/ILS switch is in the VOR position.
  The selected course is displayed as blue colored course pointer with the back part as long as the radian of the arc next to the aircraft symbol.

In case of failure the pointer in the ND disappears, ''VOR'' blinks in red color for 3 seconds and then remains fixed in the middle of the display above the aircraft symbol.
If an EFIS SGU fails, the display shows a diagonal line across the screen. The Captain or F/O can switch to the standby EFIS SGU 3 by depressing the EFIS/SGU pushbutton on the EFIS switching panel.
If a PFD or ND fails, the image which was displayed can be transferred to the corresponding display by using the PFD/ND XFR switch on the EFIS switching panel.

**ON A/C 101-200,

C. Indication
The indications of the VOR output data are as follows :
(1)In the DDRMIs:
Single pointers are associated with VOR 1 bearing information, double pointers are associated with VOR 2 if the respective VOR/ADF selection switches are in the VOR position.
Any of the following detected errors cause the corresponding VOR flag to appear:
- Loss of power
- Loss of input signal
- Loss of message validity
- Loss of computed data
- Error of servo follow up
- Software failure.

(2)In the navigation display (ND) :
VOR is mainly displayed in :
- ROSE mode : The VOR blue letter is displayed in the middle upper part of the display if ROSE mode is selected and the VOR/NAV/ILS switch is in the VOR position.
  The selected course is displayed as blue colored course pointer, the course value is displayed at the RH upper corner. The middle part of the course pointer is the lateral moveable deviation bar. The TO/FROM

is indicated by a small arrow at the respective end of the deviation bar.

- ARC mode : The VOR blue letter is displayed in the middle upper part of the display when ARC mode is selected and the VOR/NAV/ILS switch is in the VOR position.
  The selected course is displayed as blue colored course pointer with the back part as long as the radian of the arc next to the aircraft symbol.

In case of failure the pointer in the ND disappears, ''VOR'' blinks in red color for 3 seconds and then remains fixed in the middle of the display above the aircraft symbol.
If an EFIS SGU fails, the display shows a diagonal line across the screen. The Captain or F/O can switch to the standby EFIS SGU 3 by depressing the EFIS/SGU pushbutton on the EFIS switching panel.

**ON A/C 001-100,

(Ref. Fig. 019, 017)

**ON A/C 101-200,

(Ref. Fig. 019, 018)

**ON A/C ALL

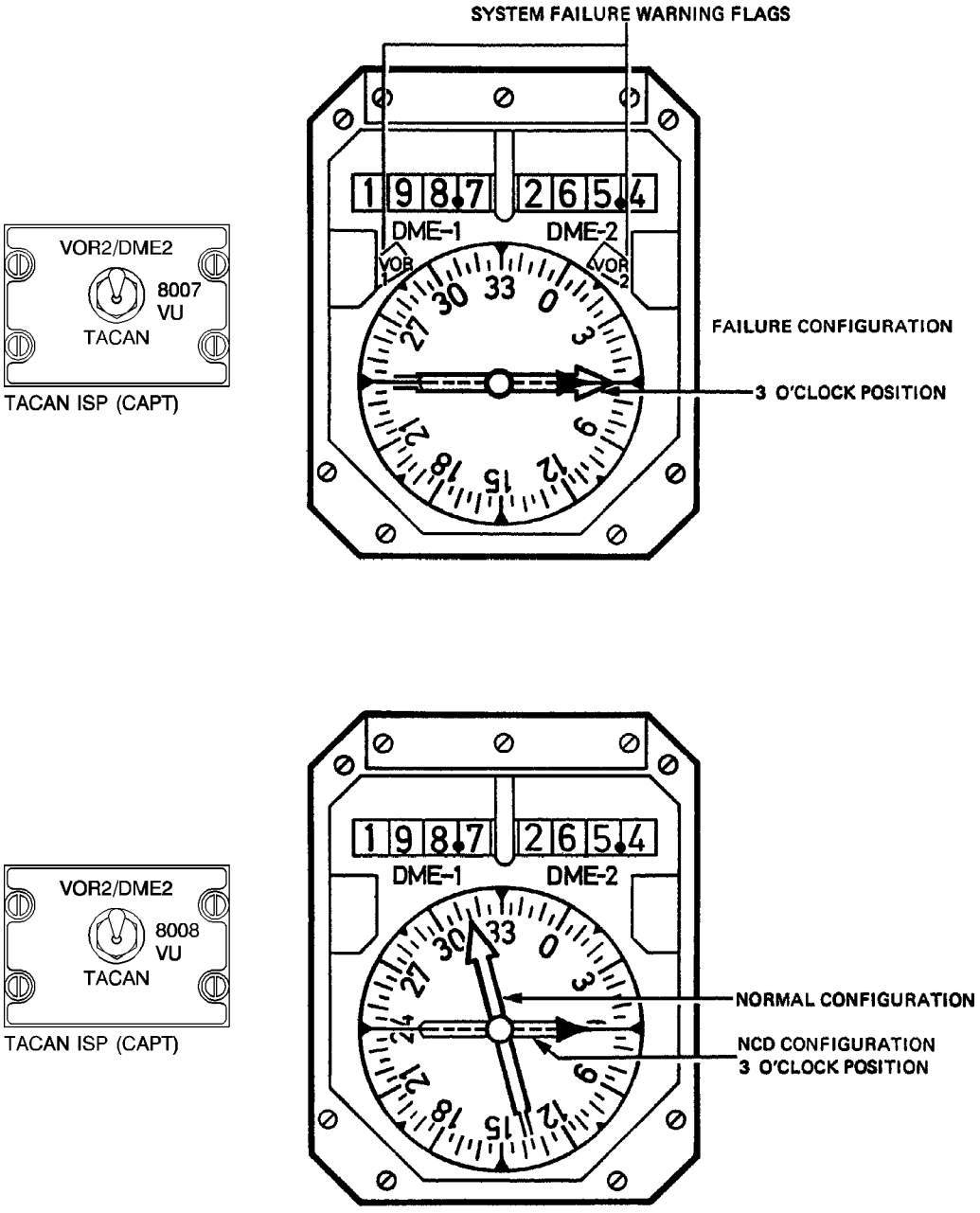
D. Lighting
The control unit is integrally lit. The light dimming is continuously controlled via turn knob on panel (414 VU) on the pedestal.

E. Audio Control
The VOR audio signal is audible in the headsets and loudspeakers controlled by the audio integrating system. ''VOR 1 or VOR 2'' must be pressed and adjusted to the right volume. The VOR/NAV/ILS switch must be in VOR position.

**ON A/C 001-100,

6. Test
The selftest (BITE) is activated by pressing and holding the VOR/MKR button on the AVIONICS SYS TEST panel or the TEST button on the VOR/MKR receiver front panel.

The LEDs on the LRU front panel will all come on for 3 seconds, then go off for 2 seconds, then display the status of the receiver (VOR green LED if good) for 4 seconds.
If the VOR receiver fails the selftest, the VOR red LED will come on.
At the same time the indicator/displays will show :

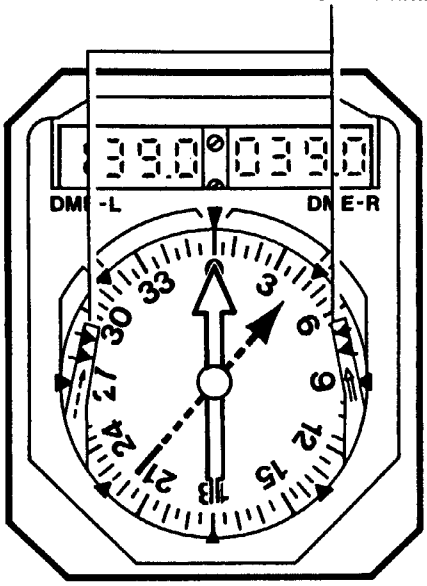


BM5 34 55 00 0 AXA0 01

DDRMI VOR
Figure 017

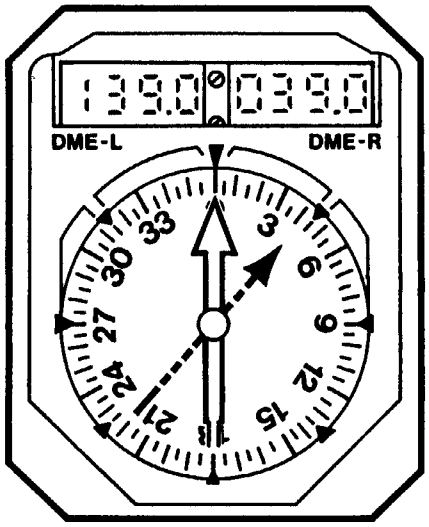
DDRMI

SYSTEM FAILURE WARNING FLAGS



VOR
FAILURE CONFIGURATION

DDRMI

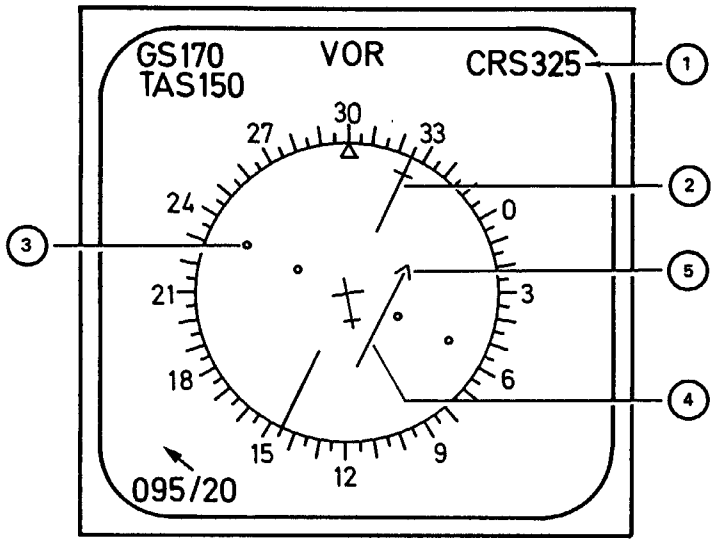


VOR
NORMAL CONFIGURATION

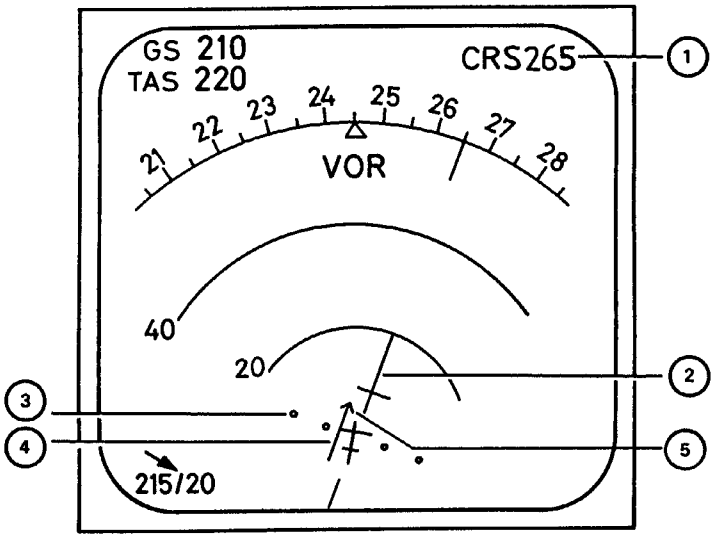
BM6 34 55 00 0 AXBO 02

DDRMI VOR
Figure 018

ND



ROSE MODE



ARC MODE

1 SELECTED COURSE ANNUNCIATOR
2 SELECTED COURSE POINTER
3 DEVIATION SCALE
4 DEVIATION BAR
5 TO/FROM INDICATOR

BM6 34 55 00 0 AZAO 01

VOR - Navigation Display
Figure 019

NO.	MESSAGE	DURATION	INDICATOR/DISPLAY
1	System failure warning	3 seconds	DDRMI : The VOR 1 or VOR 2 flag appears, VOR 1 or VOR 2 pointer moves to the 3 o'clock position. ND: ''VOR'' flashes red
2	NCD	3 seconds	DDRMI : The VOR 1 or VOR 2 flag disappears, VOR 1 or VOR 2 pointer remains in 3 o'clock position. ND : red ''VOR'' disappears
3	180° VOR bearing	3 seconds	DDRMI : VOR pointer positions at 180°. ND: deviation bar and TO/FROM indicator will show an indication with respect to the selected course.

**ON A/C 101-200,

6. Test

The selftest (BITE) is activated by pressing and holding the VOR/MKR button on the AVIONICS SYS TEST panel or the TEST button on the VOR/MKR receiver front panel.

The LEDs on the LRU front panel will all come on for 3 seconds, then go off for 3 seconds, then display the status of the receiver (green LED LRU STATUS PASS if good) for 10 seconds.
If the VOR receiver fails the selftest, the VOR red LED LRU STATUS FAIL will come on. At the same time the indicator/displays will show :

NO.	MESSAGE	DURATION	INDICATOR/DISPLAY
1	System failure warning	3 seconds	DDRMI : The VOR 1 or VOR 2 flag appears, VOR 1 or VOR 2 pointer moves to the 3 o'clock position. ND: ''VOR'' flashes red
2	NCD	3 seconds	DDRMI : The VOR 1 or VOR 2 flag disappears, VOR 1 or VOR 2 pointer remains in 3 o'clock position. ND : red ''VOR'' disappears
3	180° VOR bearing	10 seconds	DDRMI : VOR pointer positions at 180°. ND: deviation bar

NO.	MESSAGE	DURATION	INDICATOR/DISPLAY
			and **TO/FROM** indicator will show an indication with respect to the selected course.

1. Operational Test

A. Reason for the Job
(1)To ensure that the VOR receiver is operating correctly.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase, 115/200 V, 400 Hz

Referenced Procedures

- 24-41-00, P. Block 301	AC External Power Control
- 34-71-00, P. Block 501	EFIS - General
- 34-25-00, P. Block 501	Inertial Reference System (IRS)

C. Procedure
(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Energize the EFIS (Ref. 34-71-00, P. Block 501).
(d)Energize and align the IRS (Ref. 34-25-00, P. Block 501).
(e)Make certain the following circuit breakers are closed:

	PANEL	SERVICE	IDENT.	LOCATION
R	21VU	RADIO NAV & COM/VOR1	6RS1	C 2
R	21VU	RADIO NAV & COM/VOR2	6RS2	C13
	22VU	NAVIGATION/CAPT/RMI/VOR/DME	11FN1	F15
	21VU	NAVIGATION/F/O/RMI/VOR/DME	11FN2	F10

(f)Select the ROSE or ARC mode on the EFIS control panels.
(g)Place the VOR/NAV/ILS switch on the EFIS complimentary control panels in the VOR position.

NOTE : The test described below is for the VOR1. VOR2 is identical, for testing refer to information shown in brackets.

**ON A/C 001-100,

(2)Test

ACTION	RESULT
1. On panel 47OVU: - press and hold AVIONICS SYS TEST/VOR	For approx. 3 sec., a system failure is displayed.

ACTION	RESULT
MKR1 (VOR MKR2) pushbutton.	On both DDRMIs: - VOR1 (VOR2) failure flags appear. - VOR1 (VOR2) pointers turn to 3 o'clock position. On EFIS ND unit, LH (RH): - VOR failure legend flashes red. - deviation bar and TO/FROM indicator are invisible. For the next approx. 3 sec., no computed data is displayed. On both DDRMIs: - VOR1 (VOR2) flags disappear. - VOR1 (VOR2) pointers remain at 3 o'clock position. On EFIS ND unit, LH (RH): - red VOR failure legend disappears. - deviation bar and TO/FROM indicator remain invisible. For the next approx. 3 sec., a simulated bearing signal is displayed. On both DDRMIs: - VOR1 (VOR2) pointers turn to 180 degrees. On EFIS ND unit, LH (RH): - deviation bar and TO/FROM indicator appear. After approx. 9 sec., test finishes automatically. On both DDRMIs: - VOR1 (VOR2) pointers turn back to position indicated before test.
- release AVIONICS SYS TEST/ VOR MKR1 (VOR MKR2) pushbutton.	
2. On VOR/MKR1 (VOR2) receiver front panel: - press and hold TEST pushbutton.	On VOR/MKR1 (VOR 2) receiver front panel: - for approx. 3 seconds all LEDs come on. - for the next 2 seconds approx., all LEDs go off. - for the last 4 seconds approx., the green LED VOR comes on if no faults are detected during the self-test sequence. - the red LED VOR comes on, if a VOR-LRU fault is detected during the self-test sequence. - after approx. 10 seconds

ACTION	RESULT
	testing, LED goes off.
- release TEST pushbutton.	

R **ON A/C 101-200,

(2)Test

ACTION	RESULT
1. On panel 47OVU: - press and hold AVIONICS SYS TEST/VOR MKR1 (VOR MKR2) pushbutton.	For approx. 3 sec., a system failure is displayed. On both DDRMIs: - VOR1 (VOR2) failure flags appear. - VOR1 (VOR2) pointers turn to 3 o'clock position. On EFIS ND unit, LH (RH): - VOR failure legend flashes red. - deviation bar and TO/FROM indicator are invisible. For the next approx. 3 sec., a no computed data is displayed. On both DDRMIs: - VOR1 (VOR2) flags disappear. - VOR1 (VOR2) pointers remain at 3 o'clock position. On EFIS ND unit, LH (RH): - red VOR failure legend disappears. - deviation bar and TO/FROM indicator remain invisible. For the next approx. 10 sec. a simulated bearing signal is displayed. On both DDRMIs: - VOR1 (VOR2) pointers turn to 180 degrees. On EFIS ND unit, LH (RH): - deviation bar and TO/FROM indicator appear. After approx. 16 seconds test finishes automatically. On both DDRMIs: - VOR1 (VOR2) pointers turn back to the position shown before test.
- release AVIONICS SYS TEST/ VOR MKR1 (VOR MKR2) pushbutton.	
2. On VOR/MKR1 (VOR2)	On VOR/MKR1 (VOR 2)

ACTION	RESULT
receiver front panel: - press and hold TEST pushbutton.	receiver front panel: - for approx. 3 sec. all LEDs come on. - for the next 3 sec. approx., all LEDs go off. - for the last 10 sec. approx., the green LED, LRU STATUS PASS, comes on if no faults are detected during the self-test sequence. self-test sequence. - the red LED, LRU STATUS FAIL comes on, if a fault is detected during the self-test sequence. - after approx. 16 sec. testing, LED goes off.
- release TEST pushbutton.	

R **ON A/C ALL

(3)Close-Up
(a)De-energize the EFIS (Ref. 34-71-00, P. Block 501).
(b)De-energize the IRS (Ref. 34-25-00, P. Block 501).
(c)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref.24-41-00, P. Block 301).
(d)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

2. Functional Test

A. Reason for the Job
(1)To ensure correct operation of the VOR system.

B. Equipment and Materials

ITEM	DESIGNATION
(1)	Electrical Ground Power Unit - 3-Phase 115/200 V, 400 Hz
(2)	Headset (600 Ω)
(3)	VOR/ILS Ground Test Unit

Referenced Procedures	
- 23-51-00, P. Block 501	Audio Integrating
- 24-41-00, P. Block 301	AC External Power Control
- 34-71-00, P. Block 501	EFIS - General
- 34-25-00, P. Block 501	Inertial Reference System (IRS)

C. Procedure
(1)Job Set-Up
(a)Connect electrical ground power unit and energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(b)Make certain that electronics racks ventilation is correct.
(c)Energize the EFIS (Ref. 34-71-00, P. Block 501).
(d)Energize and align the IRS (Ref 34-25-00, P. Block 501).
(e)Make certain that the following circuit breakers are closed:

	PANEL	SERVICE	IDENT.	LOCATION
R	21VU	RADIO NAV & COM/VOR1	6RS1	C 2
R	21VU	RADIO NAV & COM/VOR2	6RS2	C13
	22VU	NAVIGATION/CAPT/RMI/VOR/DME	11FN1	F15
	21VU	NAVIGATION/F/O/RMI/VOR/DME	11FN2	F10

(f)Energize the audio integrating system (Ref. 23-51-00, P. Block 501).
(g)Connect a headset to each audio integrating system jack box.
(h)Select VOR1 (VOR2) mode on each audio selector panel.
(j)Position the ground test unit within range of the VOR antenna.
(k)Select ROSE or ARC mode in the EFIS control panel.
(l)Place the VOR/NAV/ILS switch on the Captain (F/O) EFIS complimentary control panel in the VOR position.

NOTE : The test described below is for the VOR1. VOR2 is identical, for testing refer to information shown in brackets.
All symbols and letters at the ND appear in blue color if not otherwise specified.

**ON A/C 001-100,

(2)Test

ACTION	RESULT
1. On control unit 3RS1 (3RS2): - select a frequency of 108.00 MHz. - select a course of 0 degrees.	On VOR/DME control unit: - 108.00 MHz and 000 degrees are displayed.
2. On ground test unit: - extend antenna and set controls to transmit a valid 0 degree TO test signal on 108.00 MHz.	On both DDRMIs: - VOR1 (VOR2) pointers indicate 0 degrees. - VOR1 (VOR2) flag is out of view. On EFIS ND unit, LH (RH): - VOR is annunciated. - selected course annunciator in the right upper corner indicates 000 degrees. - selected course pointer indi- - cates 0 degrees.

ACTION	RESULT
	- lateral deviation bar is in center position. - TO/FROM indication is TO.
3. On control unit 3RS1 (3RS2): - rotate CRS selector to 350 degrees.	On control unit 3RS1 (3RS2): - course window displays 350 degrees. On ND unit, LH (RH): - selected course annunciator indicates 350 degrees. - selected course pointer indicates 350 degrees. - lateral deviation bar is in extreme right position of course pointer.
- press CRS selector knob.	On control unit 3RS1 (3RS2): - course window displays 170 degrees. On ND unit, LH (RH): - selected course annunciator indicates 170 degrees. - selected course pointer changes to 170 degrees. - lateral deviation bar is in extreme left position of course pointer. - TO/FROM indication is FROM.
- rotate CRS selector to 190 degrees.	On control unit 3RS1 (3RS2): - course window displays 190 degrees. On ND unit, LH (RH): - selected course annunciator indicates 190 degrees. - selected course pointer indicates 190 degrees. - lateral deviation bar is in extreme right position of course pointer.
- press CRS selector knob.	On control unit 3RS1 (3RS2): - course window displays 010 degrees. On ND unit, LH (RH): - selected course annunciator indicates 010 degrees. - selected course pointer changes to 10 degrees. - lateral deviation bar is in extreme left position of course pointer. - TO/FROM indication is TO.
4. On ground test unit: - set controls to transmit a valid 0 degree FROM test signal.	On both DDRMIs: - VOR1 (VOR2) pointers indicate 180 degrees.

ACTION	RESULT
	On **ND** unit LH (RH): - lateral deviation bar is in extreme right position of course pointer. - **TO/FROM** indication is **FROM**.
5. On ground test unit: - set controls to transmit a valid **VOR** 270 degrees **FROM** test signal. On control unit **3RS1 (3RS2)**: - rotate **CRS** selector to 080 degrees.	On control unit **3RS1 (3RS2)**: - course window displays 080 degrees. On both **DDRMIs**: - **VOR1 (VOR2)** pointers indicate 90 degrees. On **ND** unit, LH (RH): - selected course annunciator indicates 80 degrees. - selected course pointer indicates 80 degrees. - lateral deviation bar is extreme right position of course pointer. - **TO/FROM** indication is **TO**.
6. On ground test unit: - set controls to transmit a valid 270 degrees **TO** signal.	On both **DDRMIs**: - **VOR1 (VOR2)** pointers indicate 270 degrees. On **ND** unit, LH (RH): - lateral deviation bar is in extreme left position of course pointer. - **TO/FROM** indication is **FROM**.
7. On ground test unit: - set controls to transmit a 1020 Hz tone output signal.	On headset: - audio tone corresponding to 1020 Hz signal is heard.
8. On Captain's audio selector panel: - rotate the **VOR1 (VOR2)** volume controller. - set loudspeakers control knob to high level.	- audio tone in headset and/or loudspeakers changes progressively and no crackling is heard.
9. Connect headset to all other available jackboxes successively and set respective loudspeaker control knobs to high level. At each station rotate the **VOR1 (VOR2)** volume controller on corresponding audio selector panel.	- audio tone in headset and/or loudspeakers changes progressively and no crackling is heard.

ACTION	RESULT
10. On ground test unit: - switch off 1020 Hz signal.	- audio tone is no longer heard.
11. On IRS1 (IRS2) control panel: - set selector switch to position OFF.	On DDRMI, LH (RH): - HDG flag, LH (RH) appears. - VOR1 (VOR2) flag appears. - pointer remains in last position. On ND unit, LH (RH): - course system is in vertical position. - HDG failure legend appears in red. - compass rose disappears. - selected course annunciator indicates same course. - course pointer disappears. - lateral deviation bar is in vertical position. - TO/FROM indicator is in the same configuration.
12. On EFIS switching panel LH (RH): - push ATT HDG.	On EFIS switching panel LH - SYS3 in white color (F/O/3 in green color) appears. On EFIS switching panel RH: - CAPT/3 in green color (SYS3 in white color) appears. On DDRMI, LH (RH): - HDG flag, LH (RH) disappears. - VOR1 (VOR2) flag disappears. - pointer moves to actual position. On ND unit, LH (RH): - red HDG failure legend disappears. - compass rose appears. - course pointer is in actual position.
13. On EFIS complementary control panel LH (RH): - set VOR/NAV/ILS switch to position NAV.	On control unit 3RS1 (3RS2): - frequency window displays dashes. - course window displays dashes: On both DDRMIs: - VOR1 (VOR2) flags remain invisible. - VOR1 (VOR2) pointers are in 3 o'clock position. On ND unit, LH (RH): - VOR legend disappears. - VOR course annunciator, course pointer, lateral deviation bar, TO/FROM indicator and lateral deviation dots disappear.

R **ON A/C 101-200,

(2)Test

ACTION	RESULT
1. On control unit 3RS1 (3RS2): - select a frequency of 108.00 MHz. - select a course of 0 degrees.	On VOR/DME control unit: - 108.00 MHz and 000 degrees are displayed.
2. On ground test unit: - extend antenna and set controls to transmit a valid 0 degree TO test signal on 108.00 MHz.	On both DDRMIs: - VOR1 (VOR2) pointers indicate 0 degrees. - VOR1 (VOR2) flag is out of view. On EFIS ND unit, LH (RH): - VOR is annunciated. - selected course annunciator in the right upper corner indicates 000 degrees. - selected course pointer indi- - cates 0 degrees. - lateral deviation bar is in center position. - TO/FROM indication is TO.
3. On control unit 3RS1 (3RS2): - rotate CRS selector to 350 degrees.	On control unit 3RS1 (3RS2): - course window displays 350 degrees. On ND unit, LH (RH): - selected course annunciator indicates 350 degrees. - selected course pointer indicates 350 degrees. - lateral deviation bar is in extreme right position of course pointer.
- press CRS selector knob.	On control unit 3RS1 (3RS2): - course window displays 170 degrees. On ND unit, LH (RH): - selected course annunciator indicates 170 degrees. - selected course pointer changes to 170 degrees. - lateral deviation bar is in extreme left position of course pointer. - TO/FROM indication is FROM.
- rotate CRS selector to 190 degrees.	On control unit 3RS1 (3RS2): - course window displays 190 degrees. On ND unit, LH (RH): - selected course annunciator indi-

ACTION	RESULT
	cates 190 degrees. - selected course pointer indicates 190 degrees. - lateral deviation bar is in extreme right position of course pointer.
- press CRS selector knob.	On control unit 3RS1 (3RS2): - course window displays 010 degrees. On ND unit, LH (RH): - selected course annunciator indicates 010 degrees. - selected course pointer changes to 10 degrees. - lateral deviation bar is in extreme left position of course pointer. - TO/FROM indication is TO.
4. On ground test unit: - set controls to transmit a valid 0 degree FROM test signal.	On both DDRMIs: - VOR1 (VOR2) pointers indicate 180 degrees. On ND unit LH (RH): - lateral deviation bar is in extreme right position of course pointer. - TO/FROM indication is FROM.
5. On ground test unit: - set controls to transmit a valid VOR 270 degrees FROM test signal. On control unit 3RS1 (3RS2): - rotate CRS selector to 080 degrees.	On control unit 3RS1 (3RS2): - course window displays 080 degrees. On both DDRMIs: - VOR1 (VOR2) pointers indicate 90 degrees. On ND unit, LH (RH): - selected course annunciator indicates 80 degrees. - selected course pointer indicates 80 degrees. - lateral deviation bar is extreme right position of course pointer. - TO/FROM indication is TO.
6. On ground test unit: - set controls to transmit a valid 270 degrees TO signal.	On both DDRMIs: - VOR1 (VOR2) pointers indicate 270 degrees. On ND unit, LH (RH): - lateral deviation bar is in extreme left position of course pointer.

ACTION	RESULT
	- TO/FROM indication is FROM.
7. On ground test unit: - set controls to transmit a 1020 Hz tone output signal.	On headset: - audio tone corresponding to 1020 Hz signal is heard.
8. On Captain's audio selector panel: - rotate the VOR1 (VOR2) volume controller. - set loudspeakers control knob to high level.	- audio tone in headset and/or loudspeakers changes progressively and no crackling is heard.
9. Connect headset to all other available jackboxes successively and set respective loudspeaker control knobs to high level. At each station rotate the VOR1 (VOR2) volume controller on corresponding audio selector panel.	- audio tone in headset and/or loudspeakers changes progressively and no crackling is heard.
10. On ground test unit: - switch off 1020 Hz signal.	- audio tone is no longer heard.
11. On IRS1 (IRS2) control panel: - set selector switch to position OFF.	On DDRMI, LH (RH): - HDG flag, LH (RH) appears. - VOR1 (VOR2) flag appears. - pointer remains in last position. On ND unit, LH (RH): - course system is in vertical position. - HDG failure legend appears in red. - compass rose disappears. - selected course annunciator indicates same course. - course pointer disappears. - lateral deviation bar is in vertical position. - TO/FROM indicator is in the same configuration.
12. On EFIS switching panel LH (RH): - push ATT HDG.	On EFIS switching panel LH - SYS3 in white color (F/O/3 in green color) appears. On EFIS switching panel RH: - CAPT/3 in green color (SYS3 in white color) appears. On DDRMI, LH (RH): - HDG flag, LH (RH) disappears.

ACTION	RESULT
	- VOR1 (VOR2) flag disappears. - pointer moves to actual position. On ND unit, LH (RH): - red HDG failure legend disappears. - compass rose appears. - course pointer is in actual position.
13. On EFIS complementary control panel LH (RH): - set VOR/NAV/ILS switch to position NAV.	On control unit 3RS1 (3RS2): - frequency window displays dashes. - course window displays dashes: On both DDRMIs: - VOR1 (VOR2) flags appear. - VOR1 (VOR2) pointers remain in last position. On ND unit, LH (RH): - VOR legend disappears. - VOR course annunciator, course pointer, lateral deviation bar, TO/FROM indicator and lateral deviation dots disappear.

R **ON A/C ALL

(3)Close-Up
(a)De-energize the EFIS (Ref. 34-71-00, P. Block 501).
(b)De-energize the IRS (Ref. 34-25-00, P. Block 501).
(c)Disengage VOR mode on the audio selector panels.
(d)Remove headset from jack box.
(e)Remove ground test equipment.
(f)De-energize the aircraft electrical network and disconnect the electrical ground power unit (Ref. 24-41-00, P. Block 301).
(g)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

1. Equipment and Material

ITEM	DESIGNATION
A.	Access Platform, 15 m (49 ft.)
B.	Blanking Caps
Referenced Procedures	
- 34-55-00, P. Block 501	VOR
- 55-34-11, P. Block 401	Vertical Stabilizer Tip

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers:

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/VOR1	6RS1	C 2
21VU	RADIO NAV & COM/VOR2	6RS2	C13

(2)Adjacent to Zone 324, position access platform.
(3)Remove vertical stabilizer tip (2) (Ref. 55-34-11, P. Block 401)

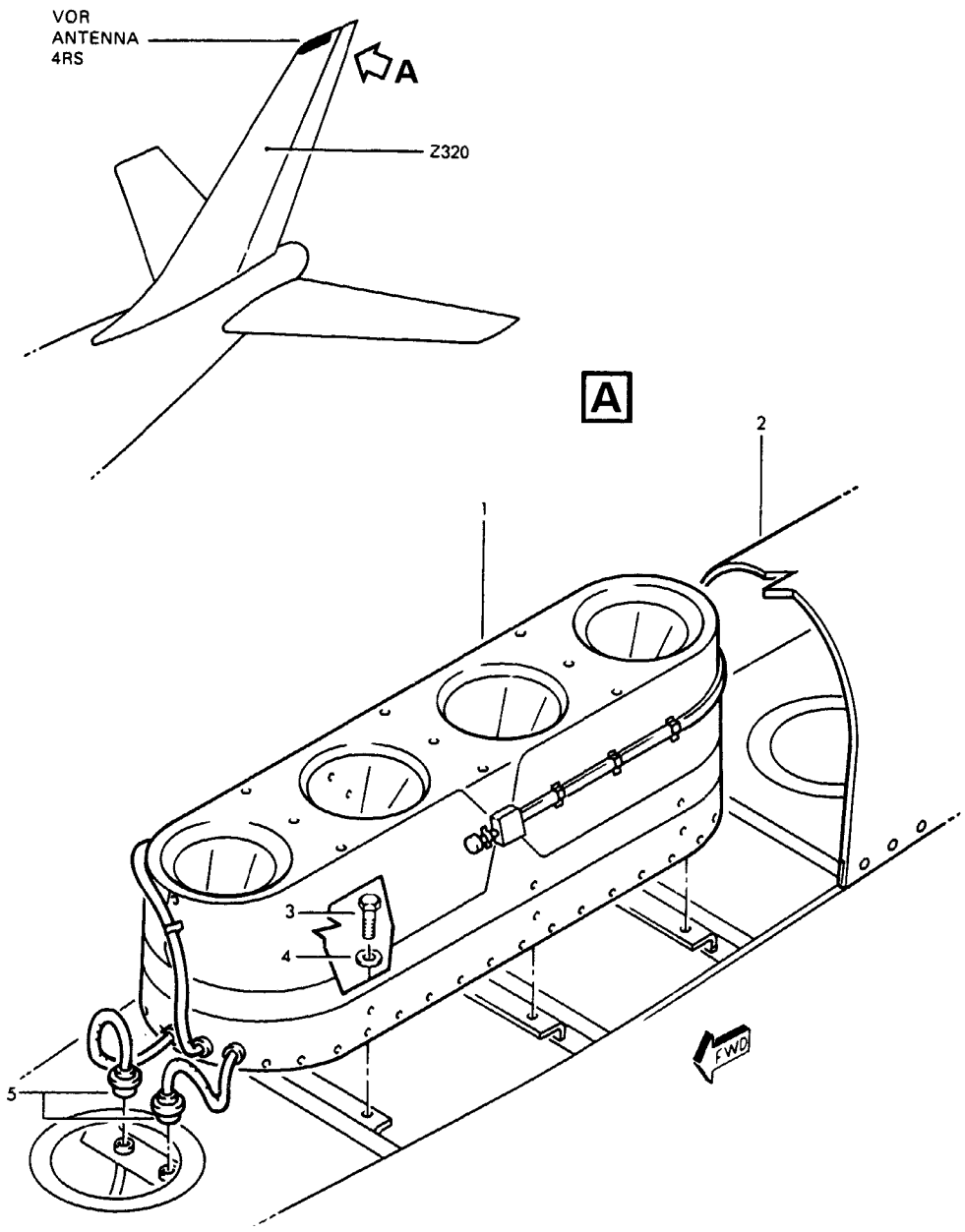
WARNING : OPENINGS FORWARD AND AFT OF ANTENNA MUST BE BLANKED DURING REMOVAL/INSTALLATION TO PREVENT ENTRY OF FOREIGN OBJECTS. (Ref. Fig. 401)

B. Removal (Ref. Fig. 401)
(1)Disconnect coaxial connectors (5).
(2)Fit blanking caps to coaxial connectors (5) and their unions.
(3)Remove bolts (3) and washers (4).
(4)Remove VOR antenna (1).

C. Installation (Ref. Fig. 401)
(1)Clean and inspect VOR antenna area for damage.
(2)Remove blanking caps from coaxial connectors (5) and unions and visually check connectors for good condition.
(3)Position VOR antenna (1).
(4)Install antenna, using bolts (3) and washers (4).
(5)Connect coaxial connectors (5).

D. Test
R (1)Carry out a VOR functional test (Ref. 34-55-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.



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VOR Antenna
Figure 401

(2)Remove blanking caps from openings forward and aft of VOR antenna.
(3)Install vertical stabilizer (2) (Ref. 55-34-11, P. Block 401).
(4)Remove access platform.

VOR/DME CONTROL UNIT 3RS1 (3RS2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-25-00, P. Block 501	IRS
- 34-73-00, P. Block 1	EFIS
(Ref. Fig. 401)	

2. Procedure

A. Job Set-Up

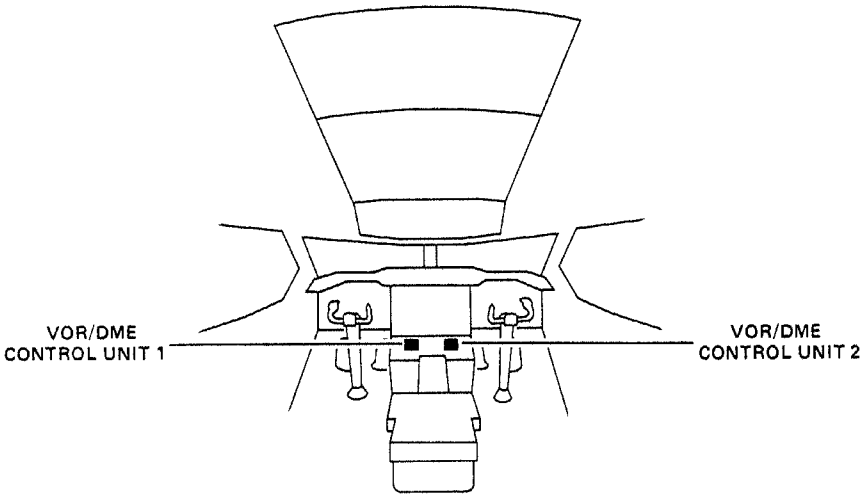
(1)Open, safety and tag the following circuit breakers :

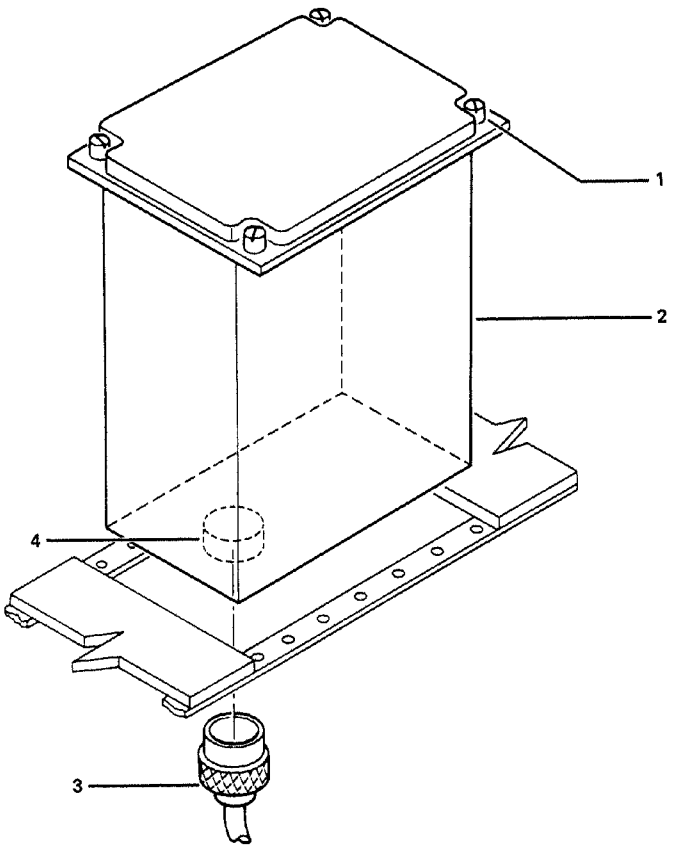
(a)For VOR/DME control unit 3RS1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/VOR1	6RS1	107/C 2
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77

(b)For VOR/DME control unit 3RS2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO NAV & COM/VOR1	6RS2	107/C13
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77





BM5 34 55 13 4 TGM2 00

VOR/DME Control Unit
Figure 401

B. Removal
(1)Unlock the four quick release fasteners (1).
(2)Withdraw VOR/DME control unit (2) from housing so as to disconnect electrical connector (3).
(3)Disconnect electrical connector (3) and remove VOR/DME control unit (2).
(4)Blank electrical connectors (3) and (4).

C. Installation
(1)Clean and inspect VOR/DME control unit interface and/or adjacent area.
(2)Remove blanking cap from electrical connectors (3) and (4) making certain that connector end is in correct condition.
(3)Position VOR/DME control unit (2) and connect electrical connector (3).
(4)Install VOR/DME control unit in housing.
(5)Lock the four quick release fasteners (1).
(6)Remove safety clips and tags and close circuit breakers
(a)For VOR/DME control unit 3RS1 : 6RS1 and 3LF
(b)For VOR/DME control unit 3RS2 : 6RS2 and 3LF

D. Test
Initial conditions
- Correct electrical power supply
- Forward sevices ventilation system in operation
- Overhead panel circuit breakers closed
- LDG GEAR PROX & RELAYS circuit breakers closed
- IRS aligned
- EFIS energized
- ROSE made selected on EFIS control panels

NOTE : The following description is valid for CAPT system. For F/O system, read between the parentheses.

1. On CAPT (F/O) complementary navigation control panel : - select VOR mode	On CAPT (F/O) ND : - VOR message is displayed on the upper half
2. On CAPT (F/O) VOR/DME control unit : - select 000° course value	On CAPT (F/O) ND : - CRS 000 indication is displayed at the upper right hand corner - selected course pointer indicates 0° on the heading scale
3. press CRS selector knob	- CRS 180 indication is displayed at the upper right hand corner. - selected course pointer indicates 180° on the heading scale

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

VOR/MKR RECEIVER 301RS1 (301RS2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-55-00, P. Block 501	VOR

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breaker :

(a)For VOR/MKR receiver 301RS1

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/VOR1	6RS1	107/C02

(b)For VOR/MKR receiver 301RS2

PANEL	SERVICE	IDENT.	LOCATION
21VU	RADIO-NAV & COM/VOR2	6RS2	107/C13

(2)Open access door 121BL and gain access to avionics compartment.

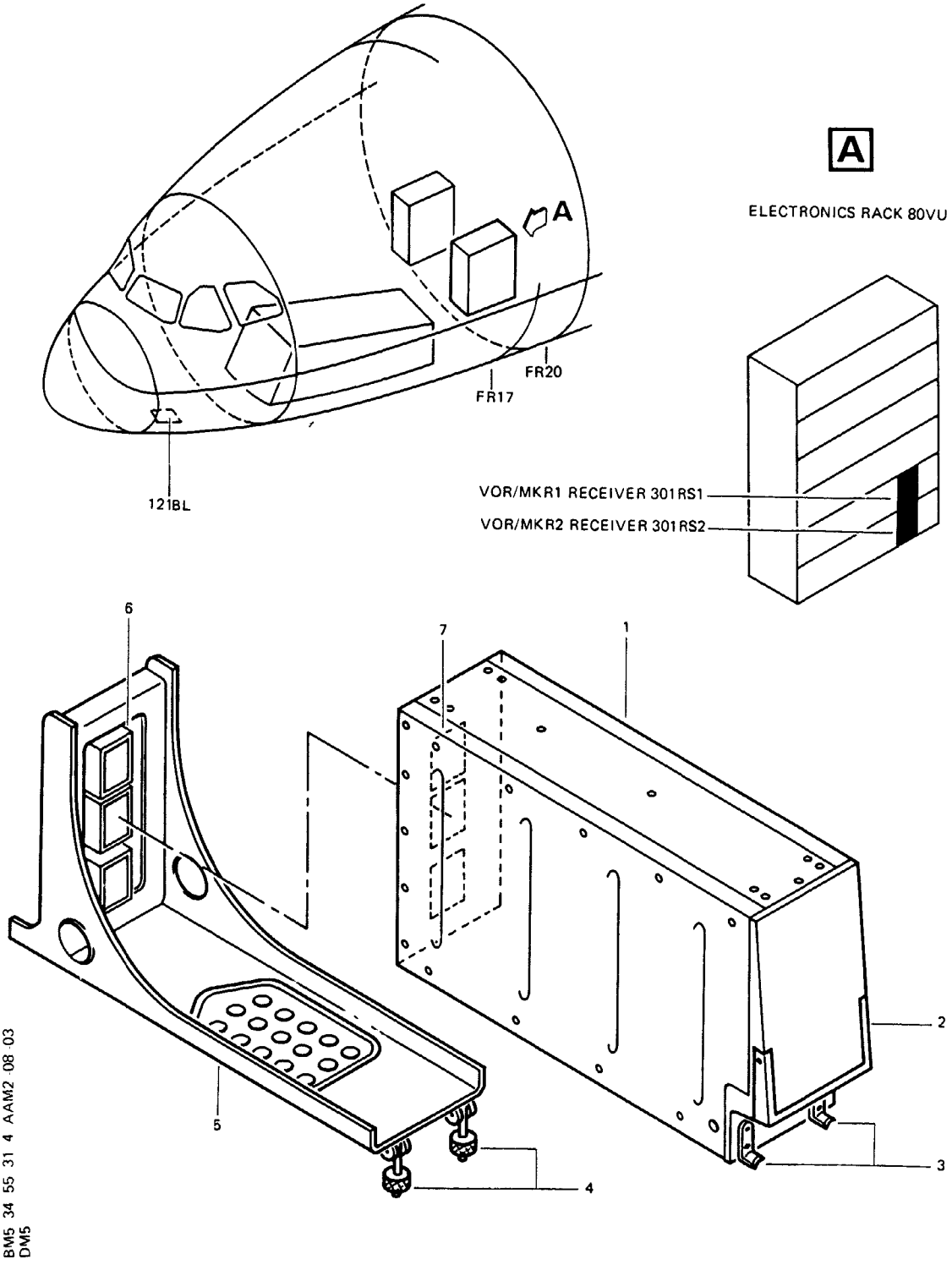
B. Removal

(1)Unscrew knurled nuts on tenons (4). Tilt tenons (4) downwards to disengage them from studs (3).

(2)Move up handle (2) and withdraw VOR/MKR receiver(1) from rack (5).

(3)Blank electrical connectors (6) and (7).

(4)Remove VOR/MKR receiver (1).



VOR/MKR Receiver
Figure 401

C. Installation
(1)Clean and inspect VOR/MKR receiver interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (6) and (7). Make certain that connectors are clean and in correct condition.
(3)Install VOR/MKR receiver (1) in rack (5).
(4)Tilt tenons (4) upwards and lift knurled nuts into position on studs (3). Tighten.
(5)Move down handle (2).
(6)Remove safety clip and tag and close circuit breaker :
(a)For VOR/MKR receiver 301RS1 : 6RS1.
(b)For VOR/MKR receiver 301RS2 : 6RS2.

D. Test
Carry out operational test of VOR/MRK receiver (Ref. 34-55-00, P. Block 501).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.

FLIGHT MANAGEMENT SYSTEM
DESCRIPTION AND OPERATION

1. General

The FMS performs the functions of management, navigation, lateral and vertical guidance and display processing.

Navigation : Horizontal navigation algorithms compute aircraft position current ground speed, track, wind information and strategy used by FMC to tune the VOR and DME radios. The lateral guidance is required for the flight plan structure.

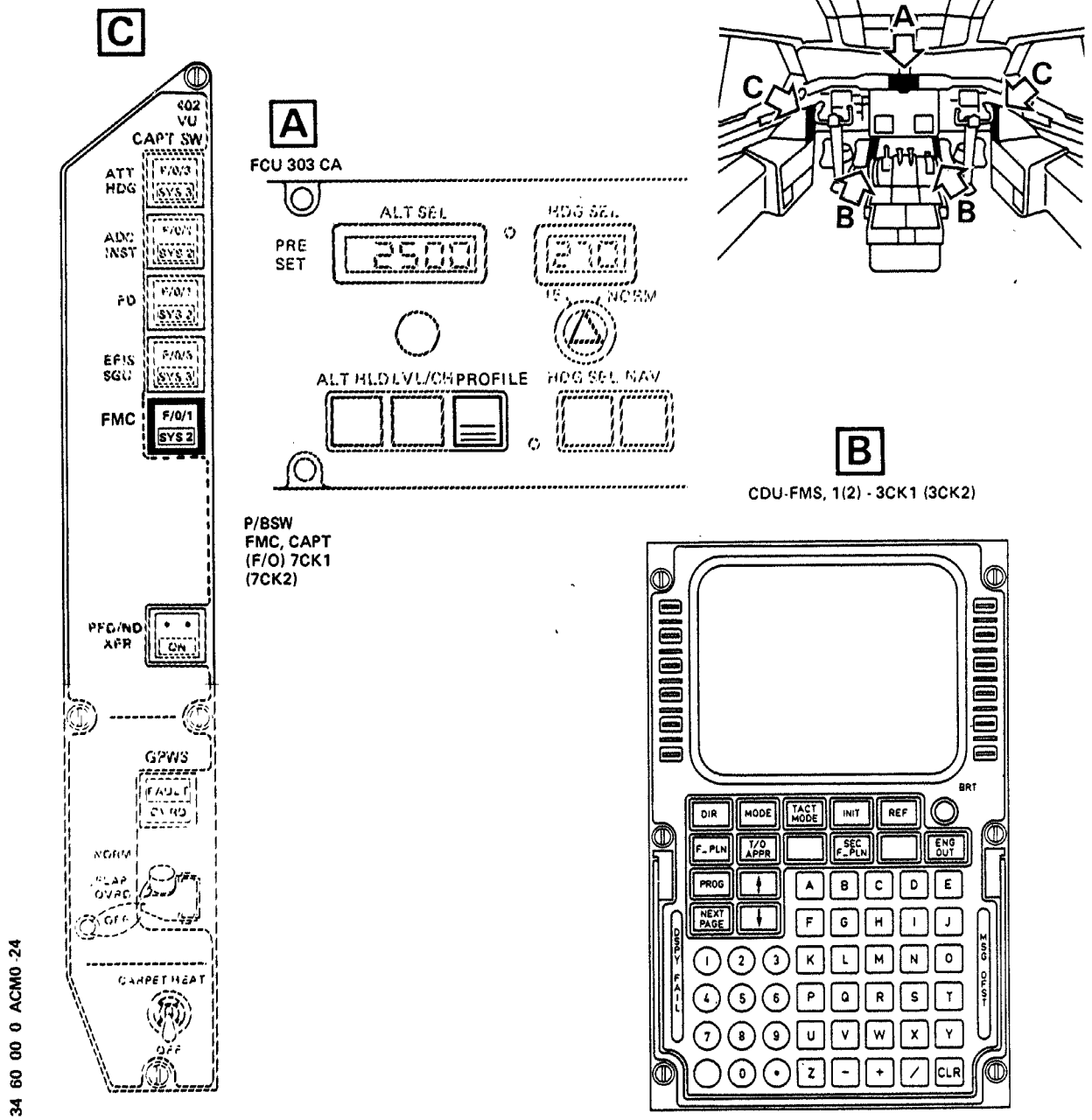
The performance functions analyze the vertical trajectory phases. The vertical guidance functions control the pitch and thrust axes of the aircraft.

Display processing is the formatting and transmission of guidance data and the provision for pilot interaction for planning purposes.

The FMS has the responsibility of recording all failure data.

2. Component Location
(Ref. Fig. 001)
(Ref. Fig. 002)

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
1CK1	FMC-1	83VU	121	121BL	34-68-34
1CK2	FMC-2	84VU	121	121BL	34-68-34
3CK1	CDU-FMS,1	8VU	210		34-68-11
3CK2	CDU-FMS,2	8VU	211		34-68-11
303CA	FCU	13VU	210		22-15-12



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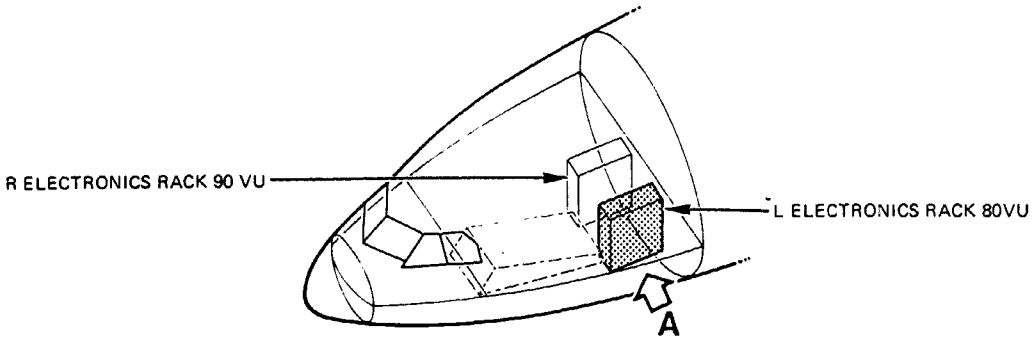
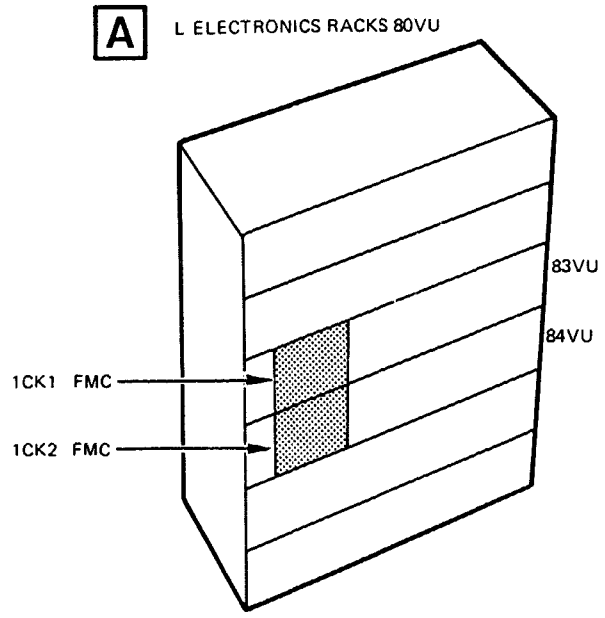
FMS - Component Location
Figure 001





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DM5

FMS - Computer Location
Figure 002

3. System Description

The FMS comprises FMCS (FMC + CDU) and peripheral systems.
The aircraft standard configuration is a dual FMC, dual CDU. FMCS architecture with respect to these peripheral systems is generally based on the split cockpit concept.
One FMCS consists of three basic elements, hardware, software and data base.
The hardware is FMC and CDU.
The software includes a system task breakdown and the philosophy used in making that breakdown. The data base contains navigation data base and the second section contains pilot specified data entered through the CDU. The data base is reloadable in the aircraft by means of a portable Data Loader.

R (Ref. Fig. 003)

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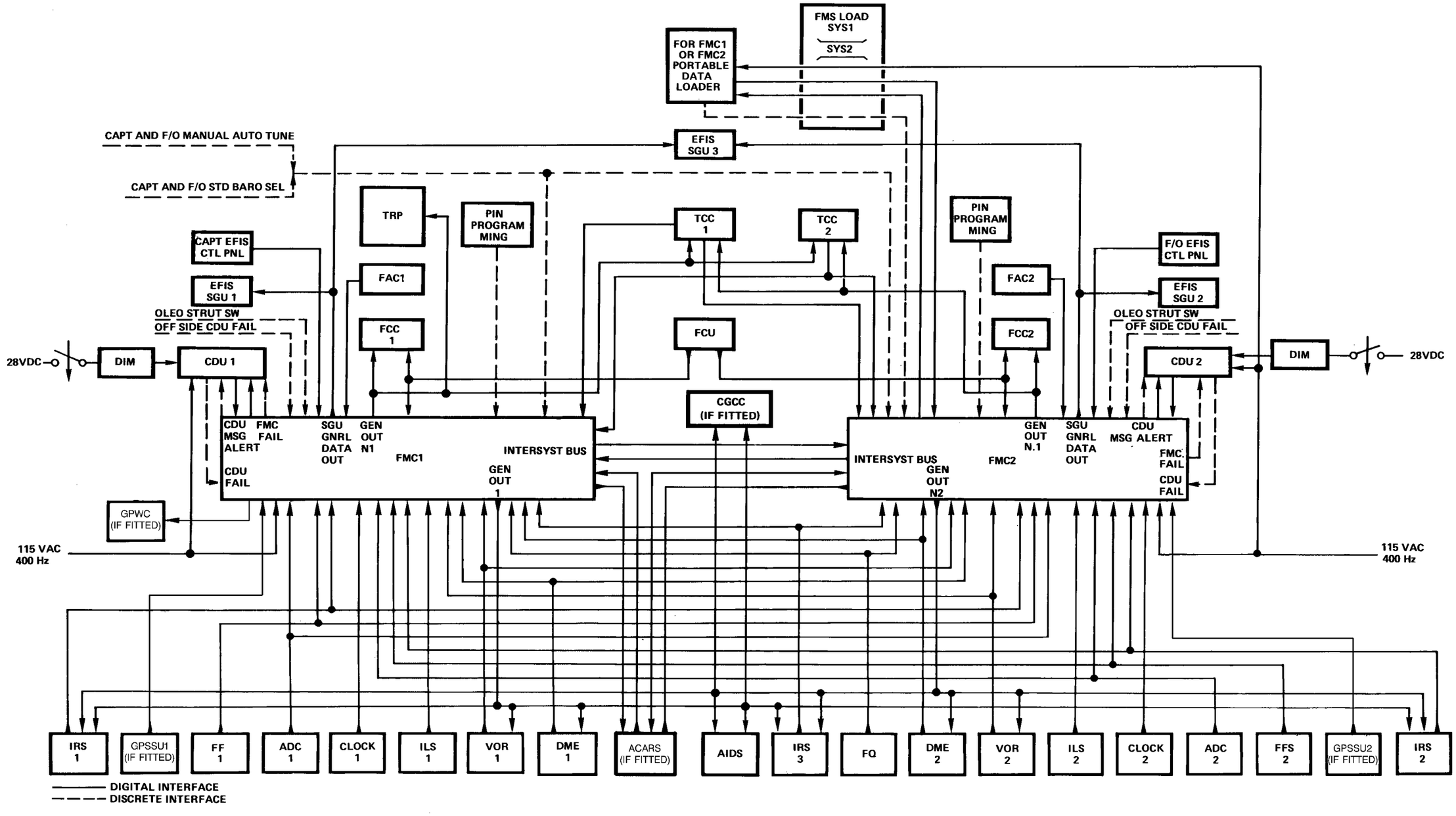

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FMS - System Interfaces
Figure 003

R

R

4. Component Description

A. Flight Management Computer (FMC)

(1)FMC

The FMC contains circuitry to support processing of information. The FMC contains a 16-bit processor that performs mathematical computations and data manipulation ; a nonvolatile magnetic rotating disc storage system for storage of programs and data bases ; a receiver subsystem for receiving data from ancillary systems ; a transmitter subsystem for transmitting data to ancillary systems ; and a memory system with a direct memory access (DMA) controller that controls subsystem use of memory. Within the FMC are both hardware and software systems which constantly monitor equipment operation.

The FMC is housed in a strong, lightweight aluminum, air-cooled, nominal size 8MCU chassis that provides single-side access to all shop replaceable units and chassis components. The chassis complies with all ARINC 600 requirements for mounting features, including handles, a lower extraction lip, a size 2 ARINC 600 connector, hold-down hooks, and identification plate.

The chassis is designed to be mounted directly on the aircraft equipment shelf, and does not require the use of vibration or shock-attenuating mounts. Cooling is in accordance with the ARINC push-through arrangement (air entering the bottom of the chassis).

Circuit cards are strong, multilayer glass-epoxy structures of uniform size and shape (except the SDP 175 processor) with integral copper thermal planes.

Covers are held in place by quarter-turn captive fasteners to facilitate removal and installation.

The covers also serve as card retainers, and cannot be fastened unless the cards are properly seated.

The face is provided with two 61-pin connectors (J1 and J2) for external access to circuit test points, a ball-type failure indicator (FMC FAIL), a TEST pushbutton switch to initiate the test function, a RESET pushbutton switch to reset the failure indicator, and elapsed time meter, and two identification plates.

The back is provided with three connectors : top, middle and bottom inserts that contain all the digital ports necessary to interface with the aircraft systems.

(Ref. Fig. 004)

(2)Electronic computation

The FMC uses three basic sub-systems :

(a)Master processor sub-system (SDP 175.3 processor) :

Four 4-bit microprocessor slices cascaded to provide 16-bit two's complement fixed point arithmetic and two additional 4-bit slice microprocessors cascaded to provide 32-bit floating point arithmetic.

(b)Transmitter-Receiver controllers :

There are two transmitter/receivers in the FMC.

The function of the ARINC 429 transmitters and their associated circuitry is to convert two TTL signal level, 16-bit data words to a single 32-bit ARINC 429-5 return-to-zero formatted bit stream and to transmit this data.

The function of the ARINC 429 receivers and their associated circuitry is to convert data from a 32-bit ARINC 429-5 return-to-zero formatted bit stream to two TTL signal level 16-bit data words and to load the data on the Input/Output Bus System when requested to do so.

R (c)Mass memory sub-systems :

R - DRAM memories

R Each dynamic RAM provides 256 K words of working memory to the R processor, which is organized as 256 K by 17 bits. Sixteen bits are R used for the data field and the seventeenth bit is used for parity R detection.

R - SRAM memories

R Each static RAM provides 16 K words of memory protection from short R term power transients. The information stored includes checkpointed R data and selected initialization programs.

R - EEPROM memories

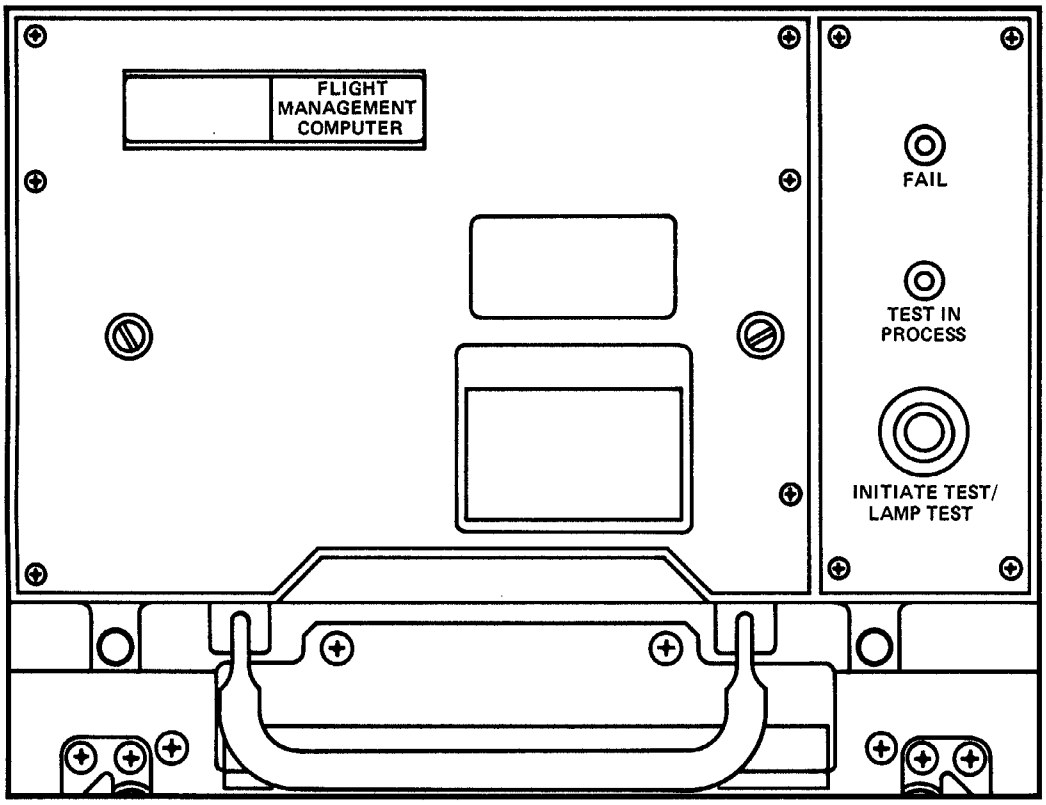
R Each electrically erasable PROM provides 2 K words of memory space R for the processor boot program which contains functions such as R power up initialization and library routines.

(3)FMC interfaces : receivers, transmitters, discrets, intersystem bus

The FMC interfaces enable the processor to acquire data from or pass data to various aircraft systems and sensors.

The FMC has 36 receivers. One receiver is reserved for testing purposes. The remaining receivers receive high-speed or low-speed data inputs. The first 8 bits of the 32-bit ARINC 429 data word are reserved for the octal label, which is a unique label for that particular information. All data received by the FMC is checked for parity and then sent to the label. Steering Ram which determines if it is data that is needed by the octal label contained in the input word. Only data that is needed is transferred into memory for processing. All output data words contain octal labels which are unique for that data. Receiving equipment will accept only that data required by it.

The FMC contains 9 ARINC 429 transmitters (5HS and 4LS) that output data for use by other systems. Low-speed transmitters 3 and 6 are the general output busses received by FCC, TCC, TRP, IRS, VOR, DME and AIDS. Low-speed transmitter 8 is used in connection with the Data Loader and low-speed transmitter 9 is the test transmitter. High-speed transmitter 1 outputs information to EFIS and high-speed transmitter 2 is for intersystem bus information. High-speed transmitters 4 and 5 are for the



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Flight Management System - Front Panel
Figure 004

CDU, onsise and offside (reserved).
All input discretes must be converted from the ARINC analog signals to compose three 16 bits data words that are placed on the FMC data bus at specific times.
In basic standard configuration the two FMCs are linked by a dedicated bus, Intersystem BUS (ISB). In case of a correct communication protocole accross the ISB 30 words are transmitted.

(4)Internal FMCS checks

These checks verify the internal operation of the FMCS by activating the internal checks performed on the FMC and CDU key hardware, software and monitor tests at long term power up, at self test and during steady state operation (The self test can be initiated only via the TEST pushbutton switch on the FMC or by CDU button push on MAINT page and while the current flight phase is Preflight or Done).

- FMC BITE :

They are : POWER checks
PROCESSOR checks
MEMORY checks
SOFTWARE checks
EXTERNAL FMCS COMMUNICATION checks
INTRA FMCS COMMUNICATION checks
DISK checks (Read and Write)

The eventual response to a self-detected failure within an FMC is to latch the FMC : fault ball indicator is set on the FMC front panel, the FMC FAIL discrete is set fail, an FMC failure message is displayed on the CDU CRT.

(5)In flight operation :

During in flight operations, input to the FMC are monitored to check source status. The FMC sets all inputs from a sensor considered to be sending no computed data invalid and attempts to use alternative inputs if valid and available by switching logic. The current Sensor Status page indicates sensor failure. BITE History records a sensor activity failure. The corresponding sensor failure discrete is set on the General Output Bus. Ground speed originates IN FLIGHT condition.

(6)FMC power supply

The FMCS utilizes Aircraft Primary Power 115VAC 400 Hz and provides six regulated dc output supply voltages. The internal power supply provides input rectification, filtering, energy storage, switching regulator, switching power bridge, over current detector/shut down, overvoltage shutdown. Monitoring generates POWER READY monitor and POWER CLEAR monitor logic discretes.

(7)Data type and definition

There are three types of digital data inputs to the FMC :

- binary numerical representation (BNR),
- binary coded decimal (BCD),
- discretes (DIS).

The FMC uses a variety of input/output signals to communicate with the aircraft. The FMC, CDU and DL use both, digital data as well as discrete inputs. These are ARINC 429-4 definitions.

- use of SSM bits (Sign Status Matrix)

All incoming data will have the SSM bits (30 and 31) set to indicate the status of the transmitting equipment. The general rule is that the FMC will only use incoming data if the SSM bits show NO. The receipt of NCD, FW or FT will be treated as a failure case.

- SDI Bits (Source Destination Identifier)

All incoming data will generally set the SDI bits (9,10) to identify the source equipment. If only one equipment is fitted to the aircraft (e.g FCU) the SDI bits will contain (0,1) if 2 or 3 items of equipment are fitted the code will be (1,0) or (1,1) respectively.

Exceptions to this rule are where the SDI bits are needed to achieve the stated resolution (e.g latitude and longitude), certain discrete or ISO 5 words, or where one equipment outputs the same label more than once (e.g engine TSP values from TCC). In this case the SDI bits will identify which parameter is coded (e.g TSP 1 or TSP 2) and will not identify the source equipment (TSP = Thrust Setting Parameter).

(8)Incoming data detail

BNR Data

32	31 30	29 ... 11	10 9 8	1
P	SSM	BNR DATA	SDI	LABEL

Where :
Label = 1-8 (8 bits)
SDI = Source Destination Identifier

10	9	LRU Assignment
0	0	0
0	1	1
1	0	2
1	1	3

BNR Data = 2's complement number
SSM = Sign Status Matrix

31	30	Assignment
0	0	Failure warning - FW
0	1	No computed data - NCD (sign must be positive)
1	0	Functional test - FT
1	1	Normal operation - NO

32, Parity = Odd

BCD Data

32	31 30 29	27 26	23 22	18 19	15 14	11 10	9 8	1
P	SSM	DIGIT 1	DIGIT 2	DIGIT 3	DIGIT 4	DIGIT 5	SDI	LABEL

Where
Label = 1-8 (8 bits)
SDI = Same as BNR
Digit No. 1 = 0-7
Digit NO. 2-5 = 0-9
Note : Unused digits are zero filled.
SSM = Sign Status Matrix

31	30	Assignment
0	0	Plus, North, East, Right, To Above
0	1	No Computed Data
1	0	Functional Test
1	1	Minus, Left, From, South, West, Below

32, Parity = Odd
Extended Accuracy (Position Data only)

32	31 30	29 28	25 24	21 20	17 16	13 12	9 8	1
P	SSM	DIGIT 1	DIGIT 2	DIGIT 3	DIGIT 4	DIGIT 5	DIGIT 6	LABEL

Where :
Digit No. 1 = 0,1
Digits No. 2-6 = 0-9
No SDI Field
Label, SSM, and Parity - same as above

Discrete Data

32	31 30	29 11	10 9	8 1
P	SSM	DISCRETES	SDI	LABEL

Where :
Discretes - typically one function per bit ; however, some encoding is found.
Label - 1-8 (8 bits)
SDI - same as for BNR
SSM - 31 | 30 | Assignment

31	30	Assignment
0	0	Valid Transmission
0	1	No Computed Data
1	0	Functional Test
1	1	Failure Warning

R

32, Parity - Odd

(9)FMC discrete inputs
There are 48 ground/open type discrete inputs available in the hardware of the FMC. The following table lists the 48 pins on the aircraft connectors AA and AB.

DISCRETE	FUNCTION	
	GROUND	OPEN
Oleostrut Switch	On Ground	Airborne
Maintenance Test	Test Command	No Test*
Mag/True	True	Magnetic*
Offside CDU Enable	Disabled	Enabled*
Master/Slave Autotune	Slave	Master*
NAV Data Base Tracks	Enabled	Disabled
Captain Manual/Autotune	Autotune	Manual
F/O Manual/Autotune	Autotune	Manual*
Offside CDU Fail	Good	Failed*
Source ID 1	FMC 1	FMC 2
Source ID 2	FMC 2	FMC 1
Onside CDU Fail	Good	Failed
Op Program	Enabled	Disabled
PERF Data Base	Enabled	Disabled
1 TCC/2 TCC	1 TCC	2 TCC
FMC/CDU 1	Disabled	Good
FMC/CDU 2	Good	Disabled
R **ON A/C 001-100,		
KG	Disabled	Good*
R **ON A/C 101-200,		
LBS	Disabled	Good*
R **ON A/C ALL		
Engine Manu 1, 2	See NOTE 1	
Engine Type 1, 2, 3	Engine option function	
Aircraft Type 1	See NOTE 2	
Aircraft Type 2	See NOTE 2	
EFIS/HSI	EFIS	HSI
R **ON A/C 001-100,		
Meters	Disabled	Good*
R **ON A/C 101-200,		
Feet	Good	Disabled*

DISCRETE	FUNCTION	
	GROUND	OPEN

R **ON A/C ALL

IRS	Ground	Ground (3IRS)
Parity	Number of grounded inputs including parity must be odd.	
Airline Type 1, 2, 3, 4, 5	Option function*	
Engine Derate Selection	Manual	Auto
Fuel Planning 1, 2, 3	Option function	
Weight Variant 1, 2, 3, 4	Option function	
Press/STD alt Sel 1	STD	Baro
Press/STD alt Sel 2	STD	Baro

* This discrete has no impact on FMS operation

R **ON A/C 001-100,

NOTE 1 :

ENG MAN 1	ENG MAN 2	FUNCTION
Open	Ground	GENERAL ELECTRIC

R **ON A/C 101-200,

NOTE 1 :

ENG MAN 1	ENG MAN 2	FUNCTION
Open	Open	PRATT AND WHITNEY

R **ON A/C ALL

NOTE 2 :

AIRCRAFT TYPE 1	AIRCRAFT TYPE 2	FUNCTION
Ground	Ground	A310-300
Open	Ground	A310-200

(10)FMC analog discrete outputs

DISCRETE	DESTINATION	FUNCTION	
		GROUNDED	OPEN
Onside FMC FAIL	Onside CDU	Good	Failed
CDU Message Alert	Onside CDU	Message	No Message

B. FMC Digital Data Inputs
(Ref. Fig. 005)
(1)Inertial Reference System (IRS)
Each IRS transmits data to the FMC on a high speed (100 KHz) ARINC 429 digital bus.
(a)Digital discretes
The IRS discretes listed in the table are transmitted at a rate of twice per second. The SSM can be encoded with 0,0,1,1 or NCD (NCD is encoded only during initial align phase). If the SSM contains 0,0 or 1,1 the transmission is valid and the discretes can be used by the FMC.

NAME	FUNCTION		BIT/LABEL
	1	0	
Align Mode/Not Ready	Align	Not Ready	11/270
Reversionary Attitude Mode	Mode Active	Inactive	12/270
Normal Mode	Normal	Not Normal	13/270
Attitude Invalid	IRS Fail	Valid	15/270
ADC Invalid	Air Data Invalid		18/270
IRU Fault	IRU Failure	Good	19/270
No IRS Initialization	IRU Waits for Data	Data Complete	22/270
Align Quality	See NOTE 1		26-28/270

NOTE 1 :

BIT			FUNCTION
28	27	26	
0	0	0	Alignment Complete
0	0	1	1 Minute before ALIGN complete
0	1	0	2 Minutes before ALIGN complete
0	1	1	3 Minutes before ALIGN complete
1	0	0	4 Minutes before ALIGN complete
1	0	1	5 Minutes before ALIGN complete
1	1	0	6 Minutes before ALIGN complete
1	1	1	7 Minutes before ALIGN complete

BM5 34 60 00 0 BAM0 11 06
DM5

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec)	SIGNIFICANT BITS/DIGITS (Inc Sign)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
PRESENT POS–LAT	010	BCD	500	6	±180	0.1	2 NM/HR	Deg/Min	NORTH
PRESENT POS–LONG	011	BCD	500	6	±180	0.1	2 NM/HR	Deg/Min	EAST
GROUND SPEED	012	BCD	500	4	0–2000	1	8	Kt	ALWAYS POSITIVE
TRACK ANGLE–TRUE	013	BCD	500	4	0–359.9	0.1	1.15	Deg	CW FROM NORTH
MAG HEADING	014	BCD	500	4	0–359.9	0.1	*	Deg	CW FROM NORTH
WIND SPEED	015	BCD	500	3	0–299	1	9	Kt	ALWAYS POSITIVE
WIND DIRECTION	016	BCD	500	3	0–359	1	10	Deg	CW FROM NORTH
SET LAD	041	BCD	~	5	±90	0.1	N/A	Deg/Min	NORTH
SET LONG	042	BCD	200	6	±180	0.1	N/A	Deg/Min	EAST
SET MAG HEADING	043	BCD	~	4	±180	0.1	N/A	Deg	CW FROM NORTH
TRUE HEADING	044	BCD	500	4	0–359.9	0.1	0.4	Deg	CW FROM NORTH
PRESENT POST–LAT	310	BNR	125	21	±180	0.00072	2 NM/HR	Deg	NORTH
PRESENT POST–LONG	311	BNR	125	21	±180	0.00072	2 NM/HR	Deg	EAST
GROUND SPEED	312	BNR	31.25	19	±4096	0.0156	8	Kt	ALWAYS POSITIVE
TRACK ANGLE TRUE	313	BNR	31.25	19	±180	2.5	1.15	Deg	CW FROM NORTH
TRUE HEADING	314	BNR	31.25	19	±180	2.5	0.4	Deg	CW FROM NORTH
WIND SPEED	315	BNR	62.50	19	0–256	0.00125	9	Kt	ALWAYS POSITIVE
WIND DIRECTION	316	BNR	62.50	19	±180	2.5	10	Deg	CW FROM NORTH
TRACK ANGLE MAG	317	BNR	31.25	19	±180	2.5	2.3	Deg	CW FROM NORTH
MAG HEADING	320	BNR	31.25	19	±180	2.5	*	Deg	CW FROM NORTH
DRIFT ANGLE	321	BNR	31.25	19	±90	2.5	2.4	Deg	RIGHT
FLIGHT PATH ANGLE	322	BNR	31.25	19	±45	2.5	0.24	Deg	UP
FLIGHT PATH ACCEL	323	BNR	15.625	19	±4	0.00000764	10%	g	FORWARD
PITCH ANGLE	324	BNR	15.625	19	±180	2.5	0.05	Deg	UP
ROLL ANGLE	325	BNR	15.625	19	±180	2.5	0.05	Deg	RIGHT WING DOWN
BODY PITCH RATE	326	BNR	15.625	19	±128	0.0005	0.1	Deg/Sec	UP
BODY ROLL RATE	327	BNR	15.625	19	±128	0.0005	0.1	Deg/Sec	RIGHT WING DOWN
BODY YAW RATE	330	BNR	15.625	19	±128	0.0005	0.1	Deg/Sec	NOSE RIGHT
BODY LONG ACCEL	331	BNR	15.625	19	±4	0.00015	0.01	g	FORWARD
BODY LATERAL ACCEL	332	BNR	15.625	19	±4	0.00015	0.01	g	RIGHT
BODY NORMAL ACCEL	333	BNR	15.625	19	±4	0.00015	0.01	g	UP
PLATFORM HEADING	334	BNR	31.25	19	±180	2.5	0.4	Deg	CW FROM Ø DEG
TRACK ANGLE RATE	335	BNR	15.625	19	±32	0.001	0.15	Deg/Sec	CLOCKWISE
INERT PITCH RATE	336	BNR	15.625	19	±128	0.0005	0.1	Deg/Sec	UP
INERT ROLL RATE	337	BNR	15.625	19	±128	0.0005	0.1	Deg/Sec	RIGHT WING DOWN
POTENTIAL V/S	360	BNR	31.25	19	4–4096	0.0396	0.5	Ft/Sec	UP
INERTIAL ALTITUDE	361	BNR	62.50	19	±131072	.0000000381	PER ARINC 706	Ft	ABOVE SEA LEVEL
ALONG TRACK ACCEL	362	BNR	15.625	19	±4	.0000000381	10%	g	FORWARD
CROSS TRACK ACCEL	363	BNR	15.625	19	±4	.0000000381	10%	g	RIGHT
VERTICAL ACCEL	364	BNR	15.625	19	±4	.0000000381	0.01	g	UP
INERTIAL V/S	365	BNR	31.25	19	±16384	0.156	30	Ft/Min	UP
N/S VELOCITY TRUE	366	BNR	62.50	19	±4096	0.0391	8	Kt	NORTH
E/W VELOCITY TRUE	367	BNR	62.50	19	±4096	0.0391	8	Kt	EAST
ACTION CODE	357	150–5							

* COMPUTED BETWEEN LATITUDES 70 DEGREES NORTH AND 60 DEGREES SOUTH ONLY
(NO COMPUTED DATA IN SSM OUTSIDE OF THIS RANGE).
2 DEGREES AT < 50 DEGREE LATITUDES
3 DEGREES AT ≥ 50 DEGREE LATITUDES

IRS Signals Identification
Figure 005

(2)Automatic Flight System (AFS)
(a)Flight Control Unit (FCU)
(Ref. Fig. 006)
The FCU transmits data to a single low speed (12.5 KHz) ARINC 429 digital bus.
1 Digital discretes
FCU discrete words 1-5 with labels 270, 271, 273, 274 and 275 are transmitted once every 56 milliseconds. The SSM can be encoded with either 0,0 or 1,1 to be used by the FMC.

DISCRETE	FUNCTION		BIT/LABEL
	1	0	
FCC 1 Command	FCC 1 in Command	Not in Command	12/270
FCC 2 Command	FCC 2 in Command	Not in Command	13/270
Bank Angle Limit Select	See Note 1		21-23/270
Heading Select Mode	Mode Requested	Not Requested	24/270
A/THR Mode Select	Mode Requested	Not Requested	25/270
SPD/MACH Knob	Pulled	Not Pulled	28/270
DFA Mode Select (if fitted)	Mode Requested	Not Requested	29/270
Altitude Hold Mode	Mode Requested	Not Requested	9/271
NAV Mode	Mode Requested	Not Requested	13/271
PROFILE Mode	Mode Requested	Not Requested	26/271
PULL ALT Knob	Requested	Not Requested	27/271
ALT SEL Knob	Requested	Not Requested	28/271
Pull HDG SEL Knob	Mode Requested	Not Requested	29/271
ALT ACQ ARM	Armed	Disarmed	12/273
NAV ARM	Armed	Disarmed	14/273
PROFILE ARM	Armed	Disarmed	15/273
LOC ARM	Armed	Disarmed	16/273
Land ARM	Armed	Disarmed	20/273
Glide Slope ARM	Armed	Disarmed	22/273
VOR	Armed	Disarmed	23/273
Climb	Armed	Disarmed	24/273
Descent	Armed	Disarmed	25/273
V/S LIMIT	Armed	Disarmed	29/273
Descent	Engaged	Disengaged	9/274
Climb	Engaged	Disengaged	10/274
SPD	Engaged	Disengaged	11/274
PROFILE	Engaged	Disengaged	12/274
ALT	Engaged	Disengaged	13/274
V/S	Engaged	Disengaged	14/274
Flare	Engaged	Disengaged	15/274
Pitch G/A	Engaged	Disengaged	16/274
Pitch T/O	Engaged	Disengaged	17/274

DISCRETE	FUNCTION		BIT/LABEL
	1	0	
Mach	Engaged	Disengaged	18/274
Glideslope	Engaged	Disengaged	19/274
Track	Engaged	Disengaged	22/274
Capture	Engaged	Disengaged	29/274
NAV	Engaged	Disengaged	11/275
HDG Hold	Engaged	Disengaged	12/275
HDG Select	Engaged	Disengaged	13/275
LOC	Engaged	Disengaged	15/275
Rollout	Engaged	Disengaged	16/275
Yaw T/O	Engaged	Disengaged	17/275
Roll G/A	Engaged	Disengaged	18/275
Capture	Engaged	Disengaged	21/275
VOR	Engaged	Disengaged	22/275
Track	Engaged	Disengaged	23/275
BTOGA Switch	Enabled	Not Enabled	25/275
LISS Validity	Valid	Invalid	27/275
Align	Engaged	Disengaged	28/275

NOTE 1 : Bank Angle Limits

BIT			FUNCTION
21	22	23	
0	0	0	NORM
0	1	1	15°

R **ON A/C 001-100,

(b)Thrust Control Computer (TCC)
(Ref. Fig. 007)
Each TCC transmits data on a low speed 12.5 KHz ARINC 429 digital bus.
1 Digital discretes
TCC discrete words with labels 273, 274 and 275 are transmitted at a rate of 16 times per second. The SSM can be encoded with either 0,0 or 1,1 to be used by the FMC.

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
SELECTED VERTICAL SPEED	020	BCD	56	4	±6000	1	N/A	Ft/Min.	UP
SELECTED HEADING	023	BCD	56	3	359	1	N/A	Deg.	CW FROM NORTH
SELECTED AIRSPEED	026	BCD	56	3	30 - 450	1	N/A	Kt.	ALWAYS POSITIVE
SELECTED HEADING	101	BNR	56	13	±180	.05	N/A	Deg.	CW FROM NORTH
SELECTED ALTITUDE	102	BNR	56	17	65536	1	N/A	Ft.	ABOVE SEA LEVEL
SELECTED AIRSPEED	103	BNR	56	12	512	.25	N/A	Kt	ALWAYS POSITIVE
SELECTED VERTICAL SPEED	104	BNR	56	11	±16384	16	N/A	Ft/Min.	UP
SELECTED MACH	106	BNR	56	13	4096	1	N/A	m Mach	ALWAYS POSITIVE

BM5 34 60 00 0 BAP0 11 06
DM5

FCU Signals Identification
Figure 006

DISCRETE	FUNCTION		BIT/LABEL
	1	0	
Air Conditioning (1,2)	See NOTE 1		11, 12/273
Wing De-Ice 1	+1	0	13/273
Wing De-Ice 2	+1	0	14/273
Nacelle Anti-Ice 1	+1	0	15/273
Nacelle Anti-Ice 2	+1	0	16/273
PMC 1 ON/OFF	On	Off	27/273
PMC 2 ON/OFF	On	Off	28/273
DFA Mode Armed	Armed	Not Armed	9/274
DFA Mode Engaged	Engaged	Disengaged	10/274
ATS Toggle Switch	Off	On	11/274
MAN THR	Armed	Off	12/274
A/TH MODE	Engaged	Not Engaged	13/274
ATS CLUTCHES OFF	Off	On	16/274
ATS-PROF Mode	Engaged	Disengaged	17/274
ATS-N1 Mode	Engaged	Disengaged	18/274
ATS-MACH MODE	Engaged	Disengaged	20/274
ATS-SPEED MODE	Engaged	Disengaged	21/274
ATS-RETARD	Engaged	Disengaged	22/274
Engine 1 Failed	Failed	Not Failed	23/274
Engine 2 Failed	Failed	Not Failed	24/274
ATS-THROTTLE PUSHER	Active	Not Active	28/274
Engine Type 1	1		11/275
Engine Type 2		0	12/275
Engine Type 3	Function of		13/275
Engine Type 4	engine		14/275
Engine Type 5	manufacturer		15/275
A/T CONTROL LIMITED	Limited	Not Limited	16/275
T/O Mode	Engaged	Disengaged	17/275
FLEX T/O Mode	Engaged	Disengaged	18/275
CLB	Engaged	Disengaged	19/275
CRZ	Engaged	Disengaged	20/275
MCT	Engaged	Disengaged	21/275
G/A	Engaged	Disengaged	22/275
THRUST LIMIT COMPUTATION	F/W	Not F/W	24/275
ADC1 Selected	Selected	Not Selected	25/275
ADC2 Selected	Selected	Not Selected	26/275
Automatic Thrust Limit	Auto	Manual	28/275

R **ON A/C 101-200,

(b)Thrust Control Computer (TCC)
(Ref. Fig. 008)
TCC transmits data on a low speed 12.5 KHz ARINC 429 digital bus.
1 Digital discretes
TCC discrete words with labels 273, 274 and 275 are transmitted at

a rate of 16 times per second. The SSM can be encoded with either 0,0 or 1,1 to be used by the FMC.

DISCRETE	FUNCTION		BIT/LABEL
	1	0	
Stator Anti-Ice	+1	0	10/273
Air Conditioning (1,2)	See NOTE 1		11, 12/273
Wing De-Ice 1	+1	0	13/273
Wing De-Ice 2	+1	0	14/273
Nacelle Anti-Ice 1	+1	0	15/273
Nacelle Anti-Ice 2	+1	0	16/273
EEC1 ON/OFF	On	Off	27/273
EEC2 ON/OFF	On	Off	28/273
DFA Mode Armed	Armed	Not Armed	9/274
DFA Mode Engaged	Engaged	Disengaged	10/274
ATS Toggle Switch	Off	On	11/274
MAN THR	Armed	Off	12/274
A/TH MODE	Engaged	Not Engaged	13/274
ATS CLUTCHES OFF	Off	On	16/274
ATS-PROF Mode	Engaged	Disengaged	17/274
ATS-EPR Mode	Engaged	Disengaged	19/274
ATS-MACH MODE	Engaged	Disengaged	20/274
ATS-SPEED MODE	Engaged	Disengaged	21/274
ATS-RETARD	Engaged	Disengaged	22/274
Engine 1 Failed	Failed	Not Failed	23/274
Engine 2 Failed	Failed	Not Failed	24/274
ATS-THROTTLE PUSHER	Activated	De-activated	28/274
Engine Type 1	1		11/275
Engine Type 2	1		12/275
Engine Type 3, 4, 5	Engine Option Function		13,14,15/275
A/T CONTROL LIMITED	Limited	Not Limited	16/275
T/O Mode	Engaged	Disengaged	17/275
FLEX T/O Mode	Engaged	Disengaged	18/275
CLB	Engaged	Disengaged	19/275
CRZ	Engaged	Disengaged	20/275
MCT	Engaged	Disengaged	21/275
G/A	Engaged	Disengaged	22/275
THRUST LIMIT COMPUTATION	F/W	Not F/W	24/275
ADC1 Selected	Selected	Not Selected	25/275
ADC2 Selected	Selected	Not Selected	26/275
Automatic Thrust Limit	Auto	Manual	28/275
Mode Selection EPR	Engaged	Disengaged	29/275

R **ON A/C ALL

NOTE 1 : Air Conditioning

11	12	Function
0	0	0
0	1	+1
1	0	-1

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (MSEC)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
SELECTED TEMPERATURE	214	BNR	125	7	± 128	1	1	° C	ABOVE FREESING
N1 ACTUAL 2 *	346	BNR	62.5	15	256	.015	**	%RPM	ALWAYS POSITIVE
N1 ACTUAL 1 *	346	BNR	62.5	15	256	.015	**	%RPM	ALWAYS POSITIVE
N1 LIMIT	342	BNR	125	15	256	.015	± 2	%RPM	ALWAYS POSITIVE
DFA TARGET HEIGHT	164	BNR	125	17	8192	.125	50	FT	ALWAYS POSITIVE
DFA SPEED	174	BNR	125	12	512	.25	1	KT (CAS) MACH	ALWAYS POSITIVE
TCC - MACH	205	BNR	125	17	± 4096	.0625 M	≠		ALWAYS POSITIVE
TCC - TAT	211	BNR	500	14	± 512	.0625	± .24	° C	ABOVE FREEZING
TCC - PRESSURE ALTITUDE	203	BNR	62.5	18	± 131072	1	≠	FT	ABOVE SEA LEVEL
TCC - TOTAL PRESSURE	242	BNR	125	17	± 2048	0.03125	1.7	MB	ALWAYS POSITIVE
TCC - IMPACT PRESSURE	215	BNR	125	15	± 512	0.03125	1.7	MB	ALWAYS POSITIVE

* THESE SIGNALS SHARE A COMMON LABEL AND ARE DIFFERENTIATED VIA THE SDI FIELD.
THE UPDATE INTERVAL DEFINED IS FOR THE SHARED LABEL. EACH INDIVIDUAL PARAMETER
THAT SHARES THIS LABEL IS UPDATED EVERY 125 MSEC.

** ± .25 ABOVE 40 PERCENT
± 3.0 15 PERCENT THROUGH 40 PERCENT
TBD 0 PERCENT THROUGH 15 PERCENT

BM5 34 60 00 0 BA50 23 18
DM5

TCC Signals Identification
Figure 007

R EFFECTIVITY: 001-100,

PIA

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SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (MSEC)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
SELECTED TEMPERATURE	214	BNR	125	7	± 128	1	1	°C	ABOVE FREEZING
EPR ACTUAL 2 ***	340	BNR	62,5	13	4	.001	**	N/A	ALWAYS POSITIVE
EPR ACTUAL 1 ***	340	BNR	62.5	13	4	.001	**	N/A	ALWAYS POSITIVE
EPR LIMIT	342	BNR	125	15	4	.001	*	N/A	ALWAYS POSITIVE
DFA TARGET HEIGHT	164	BNR	125	17	8192	.125	50	FT	ALWAYS POSITIVE
DFA SPEED	174	BNR	125	12	512	.25	1	KT (CASH) MACH	ALWAYS POSITIVE
TCC - MACH	205	BNR	125	17	± 4096	.0625 M	≠		ALWAYS POSITIVE
TCC - TAT	211	BNR	500	14	± 512	.0625	± .24	°C	ABOVE FREEZING
TCC - PRESSURE ALTITUDE	203	BNR	62.5	18	± 131072	1	≠	FT	ABOVE SEA LEVEL
TCC - TOTAL PRESSURE	242	BNR	125	17	± 2048	0.03125	1.7	MB	ALWAYS POSITIVE
TCC - IMPACT PRESSURE	215	BNR	125	15	± 512	0.03125	1.7	MB	ALWAYS POSITIVE

* LESS THAN ± 0.004 BETWEEN 1.4 AND 1.82
± 0.004 EVERYWHERE ELSE

** ± 0.004 FOR T/O AT SEA LEVEL
TBS ELSEWHERE

BM5 34 60 00 0 BARO 23 18
DM5

TCC Signals Identification
Figure 008

R EFFECTIVITY: 101-200,

PIA

(3)Air Data Computer (ADC)
(Ref. Fig. 009)
ADC signals are received on a low speed (12.5 KHz) ARINC 429 digital bus. The two ADCs both are wired to both FMCs, the FMC has a dedicated receiver for each ADC.

1 Digital discretes
ADC digital discretes with labels 270, 271 are transmitted twice per second. The SSM can be encoded with either 0,0 or 1,1 to be used by the FMC.
ADC discrete words are transmitted every 500 ms.

DISCRETE	FUNCTION		BIT/LABEL
	1	0	
ADC Invalid	ADC Fail	Good	13/270

BM5 34 60 00 0 BBT0 · 00

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
PRESSURE ALTITUDE (29.92)	203	BNR	62,5	19	± 131072	.5	*	Ft	ABOVE SEA LEVEL
BARO ALTITUDE	204	BNR	62,5	19	± 131072	.5	*	Ft	ABOVE SEA LEVEL
MACH	205	BNR	125	17	+ 4.096	0,0625	**	Mach	ALWAYS POSITIVE
CAS	206	BNR	125	19	± 1024	.0039	***	Kt	ALWAYS POSITIVE
MAX ALLOWED AIR-SPEED	207	BNR	125	17	+ 1024	.0625	±3.1	Kt	ALWAYS POSITIVE
TAS	210	BNR	125	19	+ 2048	.0078	±3.1	Kt	ALWAYS POSITIVE
TAT	211	BNR	500	19	± 512	.00195	± .24	°C	ABOVE FREEZING
ALTITUDE RATE	212	BNR	62,5	19	± 32768	.125	30	Ft/Min	UP
SAT	213	BNR	500	18	± 512	.0156	± .33	°C	ABOVE FREEZING
IMPACT PRESSURE	215	BNR	125	19	± 512	.00195	1.7	Mb	ALWAYS POSITIVE
CORRECTED STATIC PRESSURE	217	BNR	125	19	22·31	.001	N/A	Hg	ALWAYS POSITIVE
INDICATED ANGLE OF ATTACK	221	BNR	62,5	18	± 180	.0055	.25	Deg.	UP
CORRECTED ANGLE OF ATTACK	241	BNR	62,5	18	± 180	.0055	.25	Deg.	UP
TOTAL PRESSURE	242	BNR	125	19	± 2048	.0078	1.7	Mb	ALWAYS POSITIVE
BARO CORRECTION Mb1	234	BCD	125	5	745 · 1040	.1	N/A	Mb	ALWAYS POSITIVE
BARO CORRECTION Hg 1	235	BCD	125	5	22 · 31	.001	N/A	Hg.	ALWAYS POSITIVE
BARO CORRECTION Mb2	236	BCD	125	5	745 · 1050	.1	N/A	Mb	ALWAYS POSITIVE
BARO CORRECTION Hg 2	237	BCD	125	5	22 · 31	.001	N/A	Hg	ALWAYS POSITIVE
ADC MAINT 4	353	BCD	500	SEE NOTE 1					

NOTES : +11 Ft FROM -1000 TO SEA LEVEL
±14 Ft FROM SEA LEVEL TO 10,000 Ft
±21 Ft FROM 10,000 Ft TO 30,000 Ft
±44 Ft FROM 30,000 Ft TO 50,000 Ft
FOR BARO ONLY ±5 Ft ADDITIONAL LINEAR ON ALL

** ±.008 MACH AT .1 MACH
±.003 MACH AT .6 MACH
±.0027 MACH AT .7 MACH FOR ALTITUDE RANGE 20,000 TO 40,000 Ft
±.0024 MACH AT .8 MACH FOR ALTITUDE RANGE 25,000 TO 40,000 Ft.
±.0024 MACH AT .9 MACH FOR ALTITUDE RANGE 25,000 Ft TO 45,000 Ft.
±.0019 MACH AT .95 MACH FOR ALTITUDE RANGE 25,000 TO 45,000 Ft
±.002 MACH AT 1.0 MACH

*** ±3.7 Kt AT 60 Kt
±1.8 Kt AT 100 Kt
± .9 Kt AT 300 Kt
± .5 Kt AT 450 Kt

NOTE 1 : FAULT NUMBER 1, 2 RANGE IS 1 - 33
FLIGHT NUMBER RANGE IS 1 - 10

WHERE : FAULT NUMBER 1, 2 RANGE IS 1 - 33
FLIGHT NUMBER RANGE IS 1 - 10

32	31	30	29	28	25	24	21	20	17	16	13	12	9	8	1
P	SSM			DIGIT 5		DIGIT 4		DIGIT 3		DIGIT 2		DIGIT 1		354	

DIGIT — FLIGHT NUMBERS — FAULT NUMBER 2 — FAULT NUMBER 1

ADC Signals Identification
Figure 009

(4)Electronic Flight Instrument System Control Panel (EFIS CP)
(Ref. Fig. 010)
EFIS data is transmitted from the EFIS control panel to a dedicated low speed (12.5 KHz) ARINC 429 receiver in the FMC.

(a)Digital discretes
EFIS control panel transmits the discrete words with labels 271, 272 and 273 every 100 milliseconds. The SSM can be coded with either 0,0 or 1,1 to be used by the FMC.

DISCRETE	FUNCTION		BIT/LABEL
	1	0	
Map Mode	Mode Selected	Not Selected	11/272
Plan Mode	Mode Selected	Not Selected	14/272
	Requested	Not Requested	15/272
VOR-DME Option	Option Selected	Not Selected	19/272
CSTR Option	Option Selected	Not Selected	20/272
NDB Option	Option Selected	Not Selected	21/272
ARPT Option	Option Selected	Not Selected	22/272
WPT Option	Option Selected	Not Selected	23/272
Map Orientation	Track Up	Heading for Map Mode	24/272
VOR/ILS Mode	ILS	VOR	25/272
Full Rose Mode	Mode Selected	Not Selected	28/272
Test Mode	Mode Selected	Not Selected	29/272
ARC Mode	Mode Selected	Not Selected	23/273
5 NM - Map or Plan Modes	5 NM	0 NM	24/273
10 NM - Map or Plan Modes	10 NM	0 NM	25/273
20 NM - Map or Plan Modes	20 NM	0 NM	26/273
40 NM - Map or Plan Modes	40 NM	0 NM	27/273
80 NM - Map or Plan Modes	80 NM	0 NM	28/273
160 NM - Map or Plan Modes	160 NM	0 NM	29/273

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/FIGURES (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
SELECTED DECISION HEIGHT	170	BCD	200	5	± 7999.9	.1	N/A	Ft	ABOVE SEE LEVEL

BM5 34 60 00 0 BAV0 11 06
DM5

EFIS CTL PNL Signals Identification
Figure 010

(5)Distance Measuring Equipment (DME)
(Ref. Fig. 011)
There are two low-speed ARINC 429 digital receivers dedicated to receiving sequentially the frequency and computed slant range distance and, if the station is to be displayed, the slant range distance in BCD format. DME frequencies are transmitted and received in identical BCD format.
The FMC transmits a maximum of 5 DME frequencies that are then tuned by the FMC. Format is as follows :

32	31 30 29	27 26	23 22	19 18	17	16	15	14	13 11	10 9 8	1
P	SSM	10 MHz	1 MHz	.1 MHz	.05	IDENT	DSP	MLS	ILS	COMMAND	SDI	LABEL

Where :
label - 035
SDI - 0,0
Command -

13	12	11	
0	0	0	Standby Mode
0	0	1	Directed Frequency 1
0	1	0	Directed Frequency 2
0	1	1	Directed Frequency 3
1	0	0	Directed Frequency 4
1	0	1	Directed Frequency 5
1	1	0	Free Scanning Mode
1	1	1	Spare

IDENT - 1 = ACTIVE, 0 = NOT ACTIVE (AUDIO)
ILS 1 - DME is frequency paired to an ILS
MLS - Equal to zero (Not used by FMC)
DSPY - 1 = Display ; 0 = No Display
.05 - A one represents .05 MHz, 0 = 0
.1 MHz - Useable range is 0-9
1 MHz - Useable range is 0-9
10 MHz - Useable range is 0-3
SSM - 0, 0
P - Odd Parity

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
DME FREQ 1 - 4	035	BCD	*	4	108-117.95	.01	N/A	MHz	ALWAYS POSITIVE
DME FREQ (DISPLAY)	035	BCD	**	4	108-117.95	.01	N/A	MHz	ALWAYS POSITIVE
DME DISTANCE (DISPLAY)	201	BCD	**	5	± 512	.01	.05	NM	ALWAYS POSITIVE
DME DISTANCE 1 - 4 ***	202	BNR	*	17	± 512	.008	.05	NM	ALWAYS POSITIVE
DME DISTANCE (DISPLAY)***	202	BNR	**	17	± 512	.008	.05	NM	ALWAYS POSITIVE

* FREQUENCY AND DISTANCE SIGNALS ARE TRANSMITTED AS A PAIR. THE MINIMUM TIME BETWEEN THE FREQUENCY AND DISTANCE TRANSMISSIONS IS 4 BIT TIMES WHILE THE MAXIMUM IS 6.3 Ms. IDENTICAL LABELS CANNOT BE RECEIVED FROM THE DME LESS THAN 57 MILLISECONDS APART.SEE PARAGRAPH 4.G (3) FOR DIRECTED FREQUENCY SCANNING TIMING.

**THE DISPLAYED FREQUENCY AND DISTANCE IS TRANSMITTED AS A TRIPLET : FREQUENCY, DISTANCE - BNR, DISTANCE - BCD, NEW DATA IS TRANSMITTED EVERY 151.2 MILLISECONDS. THE MINIMUM TIME BETWEEN THE THREE TRANSMISSIONS IS 4 BITS TIMES WHILE THE MAXIMUM TIME IS 6.3 Ms.

***BIT 12 IS EQUAL TO ONE IF THE DISTANCE IS COUPLED WITH A DIRECTED FREQUENCY WORD.

BM5 34 60 00 0 BBM0 -11 -06
DM5

DME Signals Identification
Figure 011

(6)VHF Omni-Range (VOR)
(Ref. Fig. 012)
The FMC has two low speed (12.5 KHz) ARINC 429 digital receivers : one for the VOR 1 inputs and the other for VOR 2 inputs. VOR frequency and bearing are transmitted to FMC.

(7)Flight Augmentation Computer (FAC)
(Ref. Fig. 013)
FAC data is transmitted to a dedicated low-speed ARINC 429 receiver in the FMC.

(a)Digital discretes
The FAC transmits the digital discrete word every 125 ms. The SSM can be coded with either 0,0 or 1,1 to be used by the FMC.

DISCRETE	LABEL	BIT No.	FUNCTION	
			ONE STATE	ZERO STATE
Flap/Slat position 1	274	11	See Note 1	
Flap/Slat position 2		12	See Note 2	
Flap/Slat position 3		13	See Note 3	
Flap/Slat position 4		14	See Note 4	
Flap/Slat position 5		15	See Note 5	
Take off switch		16	Takeoff	Not takeoff
Left gear		19	Pressed	Not pressed
Right gear		20	Pressed	Not pressed
Gear switch		21	Valid	Not valid
Throttle pusher		22	Alpha ≥ alpha 0	Alpha < alpha 0

NOTE 1

1		0	
SLATS	FLAPS	SLATS	FLAPS
0°	0°	ANOTHER CONFIGURATION	

NOTE 2

1		0	
SLATS	FLAPS	SLATS	FLAPS
17°	0°	ANOTHER CONFIGURATION	

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
SELECTED COURSE 1	024	BCD	200	3	0.359	1	N/A	Deg.	CW FROM NORTH
VOR FREQUENCY	034	BCD	167-333	4	108-117.95	.01	N/A	MHz	ALWAYS POSITIVE
SELECTED COURSE 1	100	BNR	50	10	± 180	.35	N/A	Deg.	CW FROM NORTH
VOR BEARING	222	BNR	50-100	13	± 180	.044	*	Deg.	CW FROM NORTH

BM5 34 60 00 0 BFM0 11 06
DM5

VOR Signals Identification
Figure 012

NOTE 3

1			0		
SLATS	INBOARD FLAPS	OUTBOARD FLAPS	SLATS	INBOARD FLAPS	OUTBOARD FLAPS
17°	15°	8°	ANOTHER CONFIGURATION		

NOTE 4

1			0		
SLATS	INBOARD FLAPS	OUTBOARD FLAPS	SLATS	INBOARD FLAPS	OUTBOARD FLAPS
21°	22°	16°	ANOTHER CONFIGURATION		

NOTE 5

1			0		
SLATS	INBOARD FLAPS	OUTBOARD FLAPS	SLATS	INBOARD FLAPS	OUTBOARD FLAPS
27.5°	41°	31°	ANOTHER CONFIGURATION		

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/FIGURES (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
V_{MAX}	207	BNR	125	13	1024	.25	TBD	Kt*	ALWAYS POSITIVE
V_{SS} (STICK SHAKER)	256	BNR	125	12	512	.25	TBD	Kt*	ALWAYS POSITIVE
PREDICTIVE AIRSPEED VARIATION	262	BNR	125	11	256	.25	TBD	Kt*	ALWAYS POSITIVE
FLAP Min. RETRACT SPEED	263	BNR	125	12	512	.25	TBD	Kt*	ALWAYS POSITIVE
SLATS Min. RETRACT SPEED	264	BNR	125	12	512	.25	TBD	Kt*	ALWAYS POSITIVE
MANEUVRING SPEED (VM)	265	BNR	125	12	512	.25	TBD	Kt*	ALWAYS POSITIVE
V_{MIN}	245	BNR	125	14	512	.0625	TBD	Kt*	ALWAYS POSITIVE

NOTE : * KNOTS CAS

FAC Signals Identification
Figure 013

(8)Instrument Landing System (ILS)
(Ref. Fig. 014)
ILS data is transmitted to a single low speed (12.5 KHz) ARINC 429 digital receiver in the FMC. The left ILS is interfaced only to the left FMC and the right ILS is interfaced only to the right FMC. Frequency word, label 033, contains ILS category set by the FMC using the stored category information from data base.

(9)Digital clock
(Ref. Fig. 015)
Greenwich mean time is transmitted to a single low speed (12.5 KHz) ARINC 429 digital receiver in the FMC.
There are separate clocks for each FMC.
GMT BNR format, DATE BCD format are used by each FMC if the SSM contains NO.

(10)Fuel Flow (FF)
(Ref. Fig. 016)
Fuel flow left is transmitted to a dedicated low speed (12.5 KHz) ARINC 429 digital receiver in the FMC. Fuel flow right is transmitted to a different low speed ARINC 429 digital receiver in the FMC.
The two fuel flow indicators both are wired to both FMCs.

(11)Fuel quantity (FQS)
(Ref. Fig. 017)
Fuel quantity is transmitted to a dedicated low speed (12.5 KHz) ARINC 429 digital receiver in both FMCs, to calculate Fuel on board.

(12)Trim tank fuel quantity (FQS)
(Ref. Fig. 017)
Trim Tank Fuel is transmitted to a dedicated low speed (12.5 KHz) ARINC 429 digital receiver in both FMCs, to compute the aircraft CG position for prediction purposes.

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
RUNWAY HEADING	017	BCD	200	4	0.359.9	.1	N/A	Deg	ALWAYS POSITIVE
ILS FREQUENCY	033	BCD	200	4	108.111.95	.01	N/A	MHz	ALWAYS POSITIVE
RUNWAY HEADING	105	BNR	200	12	± 180	.1	1	Deg	CW FROM NORTH
LOCALIZER DEVIATION	173	BNR	200	13	± 4	.00001	*	DDM***	FLY RIGHT
GLIDE SLOPE DEVIATION	174	BNR	200	13	± 8	.0002	**	DDM****	UP

NOTES:
* CENTERED SIGNAL - .002 DDM
STANDARD DEVIATION - .004 DDM
** CENTERED SIGNAL - .003 DDM
STANDARD DEVIATION - .004 DDM
*** .0775 DDM/Deg.
**** .249375 DDM/Deg

BM5 34 60 00 0 BKM0 11 -06
DM5

ILS Signals Identification
Figure 014

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
GMT	125	300	100	5	0 - 23.59.9	.1	N/A	hr/min.	ALWAYS POSITIVE
GMT	150	BNR	100	18	SEE NOTE 1	.1	N/A	HR/MIN/SEC	ALWAYS POSITIVE
DATE	260	BCD	200	4	SEE NOTE 2	.1	N/A	DAY/MONTH	ALWAYS POSITIVE

NOTE 1 : THE FORMAT FOR GMT (BNR) IS

32	31	30	29	28	24	23	18	17	12	11	10 9	8	1
P	SSM			HOURS(BNR)		MINUTES (BNR)		SECONDS (BNR)		0	SDI		LABEL

NOTE 2 : THE FORMAT FOR DATE (BCD) IS

32	31	30	29	28	27	24	23	22	19	18	11	10 9	8	1
P	SSM		TENS	UNITS		TENS	UNITS		PAD			SDI		LABEL
			DAY			MONTH								

Clock/Date Signals Identification
Figure 015

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
FUEL FLOW LEFT	347	BNR	200	13	±32768	8	*	Lb/hr	ALWAYS POSITIVE
FUEL FLOW RIGHT	347	BNR	200	13	+32768	8	*	Lb/hr	ALWAYS POSITIVE

* THE TABLE BELOW GIVES THE ACCURACIES FOR NORMAL AND ADVERSE TEMPERATURES.

FUEL FLOW RATE (PPH)	NORMAL TEMP (PPH)	ADVERSE TEMP (PPH)
400	79	95
1000	59	75
2000	46	62
3000	34	50
4000	34	50
5000	40	58
6000	48	69
8000	69	97
12000	126	168
15000	158	214
20000	210	280
27000	284	379

BM5 34 60 00 0 BPM0 11 06
DM5

Fuel Flow Signals Identification
Figure 016

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
TOTAL FUEL QUANTITY	247	BNR	1000	14	± 655 360	40	NOTE 1	lb	ALWAYS POSITIVE
TRIM TANK FUEL QUANTITY	263	BNR	1000	15	131072	4	NOTE 1	lb	ALWAYS POSITIVE

NOTE 1:

CONFIGURATION	ATTITUDE RANGE		INDIVIDUAL TANKS
	ROLL (DEG)	PITCH (DEG)	
NORMAL GROUND	±2	±2	±1%
EXTENDED GROUND OR NORMAL FLIGHT	±3	-3 TO 5	±2%
		-3 TO -10	
EXTENDED FLIGHT	±3	5 TO 10	±3.5%
		-10 TO -15	
EXTREME FLIGHT	±3	10 TO 15	±5%

BM5 34 60 00 0 BSM0 24 18
DM5

Fuel Quantity Signals Identification
Figure 017

C. FMC Digital Outputs

(1)General output buses

The FMC has two general output buses which transmit identical data to peripheral systems, signals and digital discretes.

(2)FMC digital outputs

The FMC digital outputs correspond in format and data types to the ARINC 429-4 definition.

The rules for setting the SSM and SDI bits are described below.

(a)SSM Bits

The FMC output words will contain SSM bits set to indicate the status of the FMC. If the FMC is able to complete valid data the SSM will contain NO : if it is unable to calculate data due to lack of input data, NCD will be set in all affected data words. If the FMCS detects a failure within any of its LRUs which affects the system operation, the affected output words will have the SSM set to FW.

(b)SDI bits

Generally, each FMC will set the SDI bits of its output words to establish its identity as FMC1 or FMC2, this information is obtained from program pins MP1K and MP3K. The exceptions to this rule are certain discrete words, ISO # 5 character words or where the resolution of the signal calls for the SDI bits to be used as valid data. Also, the SDI bits of the DME frequency and distance words output to EFIS contain the identifier of the DME set supplying the data and not the source FMC.

(c)Signal definitions-failure warning

Two general rules can be stated for the SSM coding : functional test code can be treated as a failure. For any critical failure of the FMC the failure warning state is coded into the SSM of all BNR data. BCD outputs are not transmitted.

FMC failure warning : bits 13 through 19/label 351 indicate the appropriate state.

R **ON A/C 001-100,

(d)Signals format (Ref. Fig. 018)

R **ON A/C 101-200,

(d)Signals format (Ref. Fig. 019)

R **ON A/C ALL

NOTE 1 :
Date/Flight Leg

32 31 30 29	24	23	19 18	15 14	11 10	9 8	1
P | SSM	DAY	MONTH	FLIGHT LEG		SDI	260	

P - Parity
SSM - Sign Status Matrix

Day - 24 - 27 = 0 - 9
28, 29 = 10, 20, 30
Month - 19 - 22 = 0 - 9
23 = 10

NOTE 2 :
Flight Number

32 31 30 29	26 25	22 21	18 17	14 13	9 8	1
P | SSM	1000s digit	100s digit	10s digit	1s digit	PAD	Label (261)

NOTE 3 :
Documentary Data Format

32 31 30	29 27	26 24	23 21	20 18	17 15	14 12	11 10 9 8	1
P | SSM	Code 1 WEATHER Radar	Code 2 A/C STATUS	Code 3 Reason for DISC	Code 4	Code 5 SPARE	Code 6	O | SDI	262 octal

Code 1 through 6 = 3 bits octal characters

NOTE 4 :
NDB EFFECTIVE END DATE Format
SSM-0,0 = Valid effective end date ; 0.1 = NCD

32	31 30	29 28 27	24 23 22	19 18 17	11 10 9 8
P	SSM	DAY n x 10^1 | n x 10^0	MONTH n x 10^1 | n x 10^0	CY CL E NOT USED ALWAYS ZERO	SDI 263 (octal)

Cycle : 0 = 1ST cycle, 1 = second cycle of data base effectivity.

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
DISTANCE TO GO	001	BCD	200	5	±3999.9	.1	N/A	NM	TO WAYPOINT
TIME TO GO	002	BCD	200	4	0-399.9	.1	N/A	Min.	TO WAYPOINT
GROUND SPEED	012	BCD	500	4	0-2000	1	N/A	Kt	ALWAYS POSITIVE
N1 NOMINAL	021	BCD	200	4	0-256	.1	N/A	% RPM	ALWAYS POSITIVE
ILS FREQUENCY	033	BCD	200	4	108-111.95	.01	N/A	MHz	ALWAYS POSITIVE
VOR FREQUENCY	034	BCD	200	4	108-117.95	.05	N/A	MHz	ALWAYS POSITIVE
DME FREQ 1-5	035	BCD	100	4	108-117.95	.05	N/A	MHz	ALWAYS POSITIVE
SET LATITUDE	041	BCD	500	6	±180	.1	N/A	Deg : Min	NORTH
SET LONGITUDE	042	BCD	500	6	±180	.1	N/A	Deg : Min	EAST
CENTER OF GRAVITY	066	BCD	1000	5	0-100	.01	TBD	%MACH	ALWAYS POSITIVE
GROSS WEIGHT	075	BNR	200	16	1310720	40	TBD	Lb	ALWAYS POSITIVE
AIRSPEED TARGET	103	BNR	200	12	±512	.25	TBD	Kt	ALWAYS POSITIVE
MACH TARGET	106	BNR	200	13	±4096	1	TBD	mMach	ALWAYS POSITIVE
BEARING TO WAYPOINT	115	BNR	50	13	±180	.05	TBD	Deg	CW FROM NORTH
CROSSTRACK ERROR	116	BNR	50	16	±128	.004	TBD	NM	RIGHT
VERTICAL DEVIATION	117	BNR	50	12	±2048	1	TBD	Ft	ABOVE
HORIZONTAL STEERING	121	BNR	100	15	±180	.01	TBD	Deg	FLY RIGHT
VERTICAL STEERING	122	BNR	100	13	±180	.05	TBD	Deg	PITCH UP
LOC BEARING TRUE	151	BNR	200	12	±180	.1	N/A	Deg	CW FROM NORTH
DATE/FLT LEG	260	BCD	1000		SEE NOTE 1			N/A	
FLIGHT No.	261	BCD	1000		SEE NOTE 2			N/A	
DOCUMENTARY DATA	262	BCD	1000		SEE NOTE 3			N/A	N/A
NDB EFFECTIVE END DATA	263	BCD	1000		SEE NOTE 4			N/A	N/A
PRESENT POS - LAT	310	BNR	500	21	±180	0.000172	N/A	Deg :	NORTH
PRESENT POS - LONG	311	BNR	500	21	±180	0.000172	N/A	Deg :	EAST
ZFW	074	BNR	200	15	1.310.720	0.125	TBD	KT	EAST
N1 TARGET	343	BNR	200	15	± 256	.015	TBD	% RPM	ALWAYS POSITIVE

BM5 34 60 00 0 BUM0 11 06
DM5

FMC General Output Bus - Signals Identification
Figure 018

R EFFECTIVITY: 001-100,

PIA

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
DISTANCE TO GO	001	BCD	200	5	±3999.9	.1	N/A	NM	TO WAYPOINT
TIME TO GO	002	BCD	200	4	0-399.9	.1	N/A	Min.	TO WAYPOINT
GROUND SPEED	012	BCD	500	4	0-2000	1	N/A	Kt	ALWAYS POSITIVE
EPR NOMINAL	021	BCD	200	4	0-3	.001	N/A	N/A	ALWAYS POSITIVE
ILS FREQUENCY	033	BCD	200	4	108-111.95	.01	N/A	MHz	ALWAYS POSITIVE
VOR FREQUENCY	034	BCD	200	4	108-117.95	.05	N/A	MHz	ALWAYS POSITIVE
DME FREQ 1-5	035	BCD	100	4	108-117.95	.05	N/A	MHz	ALWAYS POSITIVE
SET LATITUDE	041	BCD	500	6	±180	.1	N/A	Deg : Min	NORTH
SET LONGITUDE	042	BCD	500	6	±180	.1	N/A	Deg : Min	EAST
CENTER OF GRAVITY	066	BCD	1000	5	0-100	.01	TBD	%MACH	ALWAYS POSITIVE
GROSS WEIGHT	075	BNR	200	16	1310720	40	TBD	Lb	ALWAYS POSITIVE
AIRSPEED TARGET	103	BNR	200	12	±512	.25	TBD	Kt	ALWAYS POSITIVE
MACH TARGET	106	BNR	200	13	±4096	1	TBD	mMach	ALWAYS POSITIVE
BEARING TO WAYPOINT	115	BNR	50	13	±180	.05	TBD	Deg	CW FROM NORTH
CROSSTRACK ERROR	116	BNR	50	16	±128	.004	TBD	NM	RIGHT
VERTICAL DEVIATION	117	BNR	50	12	±2048	1	TBD	Ft	ABOVE
HORIZONTAL STEERING	121	BNR	100	15	±180	.01	TBD	Deg	FLY RIGHT
VERTICAL STEERING	122	BNR	100	13	±180	.05	TBD	Deg	PITCH UP
LOC BEARING TRUE	151	BNR	200	12	±180	.1	N/A	Deg	CW FROM NORTH
DATE/FLT LEG	260	BCD	1000		SEE NOTE 1			N/A	
FLIGHT No.	261	BCD	1000		SEE NOTE 2			N/A	
DOCUMENTARY DATA	262	BCD	1000		SEE NOTE 3			N/A	N/A
NDB EFFECTIVE END DATA	263	BCD	1000		SEE NOTE 4			N/A	N/A
PRESENT POS - LAT	310	BNR	500	21	±180	0.000172	N/A	Deg :	NORTH
PRESENT POS - LONG	311	BNR	500	21	±180	0.000172	N/A	Deg :	EAST
EPR TARGET	343	BNR	200	13	±4	.001	TBD	N/A	ALWAYS POSITIVE
ZFW	074	BNR	200	15	1.310.720	0.125	TBD	KT	EAST

FMC General Output Bus - Signals Identification
Figure 019

(3)Digital discretes
FMC digital discretes with labels 270, 271 are transmitted every 100 ms. Digital discretes with labels 350, 351 and 352 are transmitted once every 10 seconds. Discretes are transmitted with SSM coded to 0,0.

	DISCRETES	FUNCTION 1	FUNCTION 0	BIT/LABEL
	No Navigation		See Note 3	13/270
	Radio Navigation		See Note 3	14/270
	Inertial Navigation		See Note 3	15/270
	FMC I/O Test	Message On	Message Off	16/270
	Decelerate	Message On	Message Off	17/270
	More Drag	Message On	Message Off	18/270
	Message	Message On	Message Off	19/270
R	**ON A/C 001-100,			
	N1	Good	Disabled	20/270
R	**ON A/C 101-200,			
	EPR	Disabled	Good	20/270
R	**ON A/C ALL			
	To/From	To	From	22/270
	Lateral Track Change Alert	On	Off	23/270
	Lateral Track Change Alert Left	On	Off	24/270
	Lateral Track Change Alert Right	On	Off	25/270
	Lateral Mode 1		See Note 1	26/270
	Lateral Mode 2		See Note 1	27/270
	Lateral Mode 3		See Note 1	28/270
	PCLB	Armed	Not armed	11/271
	PDES	Armed	Not armed	12/271
	PCLB	Engaged	Not engaged	13/271
	PALT	Engaged	Not engaged	14/271
	PDES	Engaged	Not engaged	15/271
	PSPD	Active	Not active	16/271
	PMACH	Active	Not active	17/271
	PTHR	Active	Not active	18/271
	Throttle	Idle	Not idle	19/271
	CLB	Active	Not active	20/271
	CRZ	Active	Not active	21/271
	MCT	Active	Not active	22/271
	Vertical Mode 1	See Note 2		23/271
	Vertical Mode 2	See Note 2		24/271
	Vertical Mode 3	See Note 2		25/271
	Vertical Mode 4	See Note 2		26/271
	A/T Control	Thrust	Speed	27/271

DISCRETES	FUNCTION		BIT/LABEL
	1	0	
Altitude Alert	On	Off	28/271
VDEV Display	Display	No display	29/271
IRS	Failed	Good	9/350
IRS	Failed	Good	10/350
IRS	Failed	Good	11/350
ADC 1	Failed	Good	12/350
ADC 2	Failed	Good	13/350
EFIS CP	Failed	Good	14/350
TCC 1	Failed	Good	15/350
TCC 2 (If fitted)	Failed	Good	16/350
FAC	Failed	Good	17/350
Fuel Flow 1	Failed	Good	18/350
Fuel Flow 2	Failed	Good	19/350
Fuel Totalizer	Failed	Good	20/350
FCU	Failed	Good	21/350
ILS	Failed	Good	22/350
VOR 1	Failed	Good	23/350
VOR 2	Failed	Good	24/350
Clock	Failed	Good	25/350
DME 1	Failed	Good	26/350
DME 2	Failed	Good	27/350
Parity	Failed	Good	28/350
Data Loader	Failed	Good	29/350
Onside CDU	Failed	Good	11/351
SPD 175	Failed	Good	13/351
FMC Program RAM	Failed	Good	14/351
FMC Steering RAM	Failed	Good	15/351
FMC PROM	Failed	Good	16/351
DISK	Failed	Good	17/351
FMC Heartbeat Monitor	Failed	Good	18/351
Intersystem Bus	Failed	Good	19/351
FMC ARINC 429 Transmitters	Failed	Good	20/351
FMC ARINC 429 Receivers	Failed	Good	21/351
FMC Power	Failed	Good	22/351
FMC Configuration	Failed	Good	23/351
FMC Data Base	Failed	Good	24/351
FMC Sync	Failed	Good	25/351
FMC Exception	Failed	Good	26/351
CRT High Voltage Loss	Failed	Good	15/352
CDU Buffer RAM	Failed	Good	17/352
CDU PROM	Failed	Good	18/352
CDU Display RAM	Failed	Good	19/352
CRT	Failed	Good	21/352
CDU Program Memory Sequence	Failed	Good	22/352
8085 Microprocessor	Failed	Good	23/352

NOTE 1 : Lateral mode

BIT 26 LABEL 270	BIT 27 LABEL 270	BIT 28 LABEL 270	LATERAL SUBMODES
0	0	0	None
0	0	1	Holding Pattern (HF, HA, HM)
0	1	0	Procedure Turn (PI, PM)
0	1	1	DME ARC (AF)
1	0	0	Heading (VI, VR, VD, VA, VM)
1	0	1	Direct (DF)
1	1	0	Offset
1	1	1	Course/Track (CF, TF, FA, FM)

NOTE 2 : Vertical mode

VERTICAL MODE 1	VERTICAL MODE 2	VERTICAL MODE 3	VERTICAL MODE	FUNCTION
0	0	0	0	No Mode
0	0	0	1	Minimum Time
0	0	1	0	Economy
0	0	1	1	Minimum Fuel
0	1	0	0	Maximum Climb
0	1	0	1	Maximum Descent
0	1	1	0	Speed
0	1	1	1	Maximum Endurance
1	0	0	0	Engine Out
1	0	0	1	Deceleration
1	0	1	0	Immediate Descent
1	0	1	1	Immediate Climb

NOTE 3 : Navigation mode

NO NAV	RADIO NAV	INERTIAL NAV	FUNCTION
0	0	0	Dead Reckoning
0	0	1	Inertial Only
0	1	0	Radio Only
0	1	1	Radio/Inertial
1	0	0	No Navigation

(4)FMC general output bus to EFIS
(Ref. Fig. 020)
(a)EFIS general output bus transmits three words of digital discretes : start of dynamic data, FMC discrete 1 and FMC discrete 2.
Start of dynamic data is used by the FMC to indicate that a new set of dynamic data follows. FMC discrete words 1 and 2 contain specific instructions and status of FMC operation for EFIS display. Message discretes are :
- FMC I/O TEST : if the test mode digital discrete input from the EFIS CP is active this message discrete is set to 1 otherwise this discrete is set to 0.
- DECELERATE : when the CDU message number 10 is displayed on the CDU, this message discrete is set to "1". Otherwise, the discrete is set to "0".
- MORE DRAG : when the CDU message number 6 is displayed on the CDU, this message discrete is set to "1". Otherwise, the discrete is set to "0".
- MESSAGE : when CDU message number is displayed on the CDU, the message discretes are set to 1 otherwise these discretes are set to 0.

The Start of Dynamic Data (SOD) discrete word is transmitted every 50 ms while FMC digital discretes with the labels 270, 271 are transmitted every 100 ms.
The bit assignments for the two discrete words are as follows :

	DISCRETES	FUNCTION 1	FUNCTION 0	BIT/LABEL
	NO Navigation	See Note 3		13/270
	Radio Navigation	See Note 3		14/270
	Inertial Navigation	See Note 3		15/270
	FMC I/O Test	Message On	Message Off	16/270
	Message	Message On	Message Off	19/270
R	**ON A/C 001-100,			
	N1	Good	Disabled	20/270
R	**ON A/C 101-200,			
	EPR	Disabled	Good	20/270
R	**ON A/C ALL			
	To/From	To	From	22/270
	Lateral Track Change Alert Left	On	Off	24/270
	Lateral Track Change Alert Right	On	Off	25/270
	Lateral Mode 1	See Note 1		26/270
	lateral Mode 2	See Note 1		27/270

DISCRETES	FUNCTION		BIT/LABEL
	1	0	
Lateral Mode 3	See Note 1		28/270
PCLB	Armed	Not Armed	11/271
PDES	Armed	Not Armed	12/271
PCLB	Engaged	Not Engaged	13/271
PALT	Engaged	Not Engaged	14/271
PDES	Engaged	Not Engaged	15/271
PSPD	Active	Not Active	16/271
PMACH	Active	Not Active	17/271
PTHR	Active	Not Active	18/271
Throttle	Idle	Not Idle	19/271
CLB	Active	Not Active	20/271
CRZ	Active	Not Active	21/271
MCT	Active	Not Active	22/271
Vertical Mode 1	See Note 2		23/271
Vertical Mode 2	See Note 2		24/271
Vertical Mode 3	See Note 2		25/271
Vertical Mode 4	See Note 2		26/271
A/T Control	Thrust	Speed	27/271
Altitude Alert	On	Off	28/271
Vertical Deviation Display	Limited	Not Limited	29/271
Start of Dynamic Data	Bits 9-29 are equal to zero		303

NOTE 1 : Lateral mode

BIT 26 LABEL 270	BIT 27 LABEL 270	BIT 28 LABEL 270	LATERAL SUBMODES
0	0	0	None
0	0	1	Holding Pattern (HA, HF, HM)
0	1	0	Procedure Turn (PI, PM)
0	1	1	DME ARC (AF)
1	0	0	Heading (VI, VR, VD, VA, VM)
1	0	1	Direct (DF)
1	1	0	Offset
1	1	1	Course/Track (CF, TF, FA, FM)

NOTE 2 : Vertical mode

VERTICAL MODE 1	VERTICAL MODE 2	VERTICAL MODE 3	VERTICAL MODE 4	FUNCTION
0	0	0	0	No Mode
0	0	0	1	Minimum Time
0	0	1	0	Economy
0	0	1	1	Minimum Fuel
0	1	0	0	Maximum Climb
0	1	0	1	Maximum Descent

VERTICAL MODE 1	VERTICAL MODE 2	VERTICAL MODE 3	VERTICAL MODE 4	FUNCTION
0	1	1	0	Speed
0	1	1	1	Maximum Endurance
1	0	0	1	Deceleration
1	0	0	0	Engine out
1	0	1	0	Immediate Descent
1	0	1	1	Immediate Climb

NOTE 3 : Navigation mode

No NAV	RADIO NAV	INERTIAL NAV	FUNCTION
0	0	0	Dead Reckoning
0	0	1	Inertial Only
0	1	0	Radio Only
0	1	1	Radio/Inertial
1	0	0	No Navigation

SIGNAL	OCTAL LABEL	FORMAT	UPDATE INTERVAL (msec.)	SIGNIFICANT BITS/DIGITS (INC SIGN)	RANGE	RESOLUTION	ACCURACY	UNITS	POSITIVE SENSE
DISTANCE TO WAYPOINT	001	BCD	200	5	±3999.9	.1	N/A	NM	TO WAYPOINT
TIME TO GO	002	BCD	200	4	0-399.9	.1	N/A	Min.	ALWAYS POSITIVE
GROUNDSPEED	012	BCD	500	4	0-2000	1	N/A	Kt.	ALWAYS POSITIVE
DME DISPLAY FREQ 1	035	BCD	200	4	108-117.95	.01	N/A	MHz	ALWAYS POSITIVE
DME DISPLAY FREQ 2	035	BCD	200	4	108-117.95	.01	N/A	MHz	ALWAYS POSITIVE
V1	073	BNR	200	12	±512	.25	N/A	Kt.	ALWAYS POSITIVE
TARGET SPEED	103	BNR	200	12	±512	.25	TBD	Kt.	ALWAYS POSITIVE
DESIRED TRACK	114	BNR	50	13	±180	.05	TBD	Deg.	CW FROM NORTH
BEARING TO WAYPOINT	115	BNR	50	13	±180	.05	TBD	Deg.	CW FROM NORTH
CROSSTRACK ERROR	116	BNR	50	15	±128	.004	TBD	NM	RIGHT OF PATH
VERTICAL DEVIATION	117	BNR	50	12	±2048	1	TBD	Ft.	ABOVE PATH
ILS/DME DISTANCE	154	BNR	200	17	0-512	.008	N/A	NM	ALWAYS POSITIVE
MDA	164	BNR	1000	16	0-8192	TBS	TBS	Ft.	ABOVE
DME DISTANCE - 1	202	BNR	200	17	0-512	.008	N/A	NM	ALWAYS POSITIVE
DME DISTANCE - 2	202	SNR	200	17	0-512	.008	N/A	NM	ALWAYS POSITIVE
PRESENT POS - LAT	310	BNR	100	21	±180	.000172	TBD	Deg.	NORTH
PRESENT POS - LONG	311	BNR	100	21	±180	.000172	TBD	Deg.	EAST
GROUNDSPEED	312	BNR	50	16	±4096	.125	TBD	Kt.	ALWAYS POSITIVE
TRACK ANGLE - TRUE	313	BNR	50	13	±180	.05	TBD	Deg.	CW FROM NORTH
TRUE HEADING	314	BNR	50	13	±180	.05	TBD	Deg.	CW FROM NORTH
WIND SPEED	315	BNR	100	10	±256	.5	TBD	Kt.	ALWAYS POSITIVE
WIND DIRECTION	316	BNR	100	10	±180	.35	TBD	Deg.	CW FROM NORTH
TRACK ANGLE - MAG	317	BNR	50	13	±180	.05	TBD	Deg.	CW FROM NORTH
FLIGHT PATH ANGLE	322	BNR	50	13	±180	.05	TBD	Deg.	UP
FLIGHT PATH ACCEL	323	BNR	50	13	±4	.001	TBD	g	FORWARD
ACTIVE WPT IDENT.	356, 357	ISO5	1000	SEE NOTE					

NOTE : ISO5 FORMAT

32	31	30	29	23	22	16	15	9	8	1
P	SSM	CHAR 3		CHAR 2		CHAR 1		357 (8 BITS)		

P - PARITY

SSM - 31 30
- 1 1 ACTIVE WPT IDENT
- 0 1 MESSAGE ACTIVE
- MESSAGE NOT ACTIVE

CHAR 1, 2, 3 ISO ALPHABET 5 CODE

BM5 34 60 00 0 BXM0 11 06
DM5

FMC to EFIS Signals Identification
Figure 020

(b)Background data

The FMC transmits map background data for 2 modes, MAP and PLAN, but adds also in Rose mode the EFIS discretes.

1 Data formats

Data are output at 50 ms intervals, interleaved with dynamic data. Six basic formats are used by the FMC for all map background data : position, character, distance (NM), length (Ft), angular and discrete. These formats conform to the basic ARINC 429 serial word fields where bits 1 through 8 are the label, bits 9 through 29 are for data (9, 10 are sometimes SDI data), bits 30 and 31 are for SSM, and bit 32 is for parity. The SSM is coded for all background data as given :

BIT 31	BIT 30	FUNCTION
0	0	Intermediate word of a word group
0	1	First word of a word group
1	0	Last word of a word group
1	1	Control word of a word group

2 Vector word group

- eight symbols word groups are used by the FMC to identify a point on the earth.

3 Symbol word group

- six different types of vector word groups are used by the FMC to transmit path description data (Flight Plan Segments).

4 Map reference word group

Map reference word groups use two data formats :

- position,
- discrete : modes/options and range.

5 Control word groups

Control word groups are used to identify the begining and end of a 64 word block.

6 Data transmission rules

The FMC transmits map background for five modes : MAP, PLAN, ROSE, ARC and test.

(c)EFIS CTL PNL

From the EFIS CTL PNL the flight crew can select on the ND either MAP, PLAN, ROSE, ARC mode and TEST. The ARC mode is a degraded MAP mode (without FMC). On the range selector switch the flight crew can select any one of the five positions that corresponds to PLAN and MAP mode : Viewing distances of 15, 30, 60, 120 and 240 NM on the display. In addition the crew may select data options : Navaids, airports (not including origin or destination ARPT and flight Plan waypoints), Flight Plan Waypoints constraints, waypoints (not including Flight Plan Waypoints), non directional Beacons (NDB).

**ON A/C 101-200,

R

(d)GPWS
FMC 1 transmits the following data to the GPWS
- Present Position Latitude (label 310)
- Present Position Longitude (label 311)
- Magnetic Track Angle (label 317)

R **ON A/C ALL

(5)FMC outputs to CDU
This output consists of a high speed ARINC 429 file output.
The FMC transmits the following types of message to the CDU :
- ACK/NAK message (acknowledge/not acknowledge message Label 302)
- display update message (Label 303)
- Scratchpad message (Label 306)
- discrete word message (Label 270)

(6)Flight test
The flight test bus provides the capability to transmit up to 160 different parameters. All parameters are transmitted at a 10-hertz rate. The octal label, range, format, and number of significant bits will vary depending upon the particular flight test application.

(7)Intersystem Bus (ISB)
In the basic configuration there are two FMCs which are linked by a dedicated bus.
The transmission is per file-format and the basic control words for the control process are the words 301, 303, and 304.
Because of the configuration of FAC and CLOCK, their used signals are also transmitted across the ISB.
In case of a correct communication protocal across the ISB 30 words are transmitted starting from octal label 335 through 372. They contain information like
- Initialization (NAV data base serial number, OP Progr ID, Engine Type, and SDI)
- Steady state comparison (F-PLN, CDU entry sequence No, PPOS, NAV Eng, GMT)
- Duties controlled by master/slave FMC.

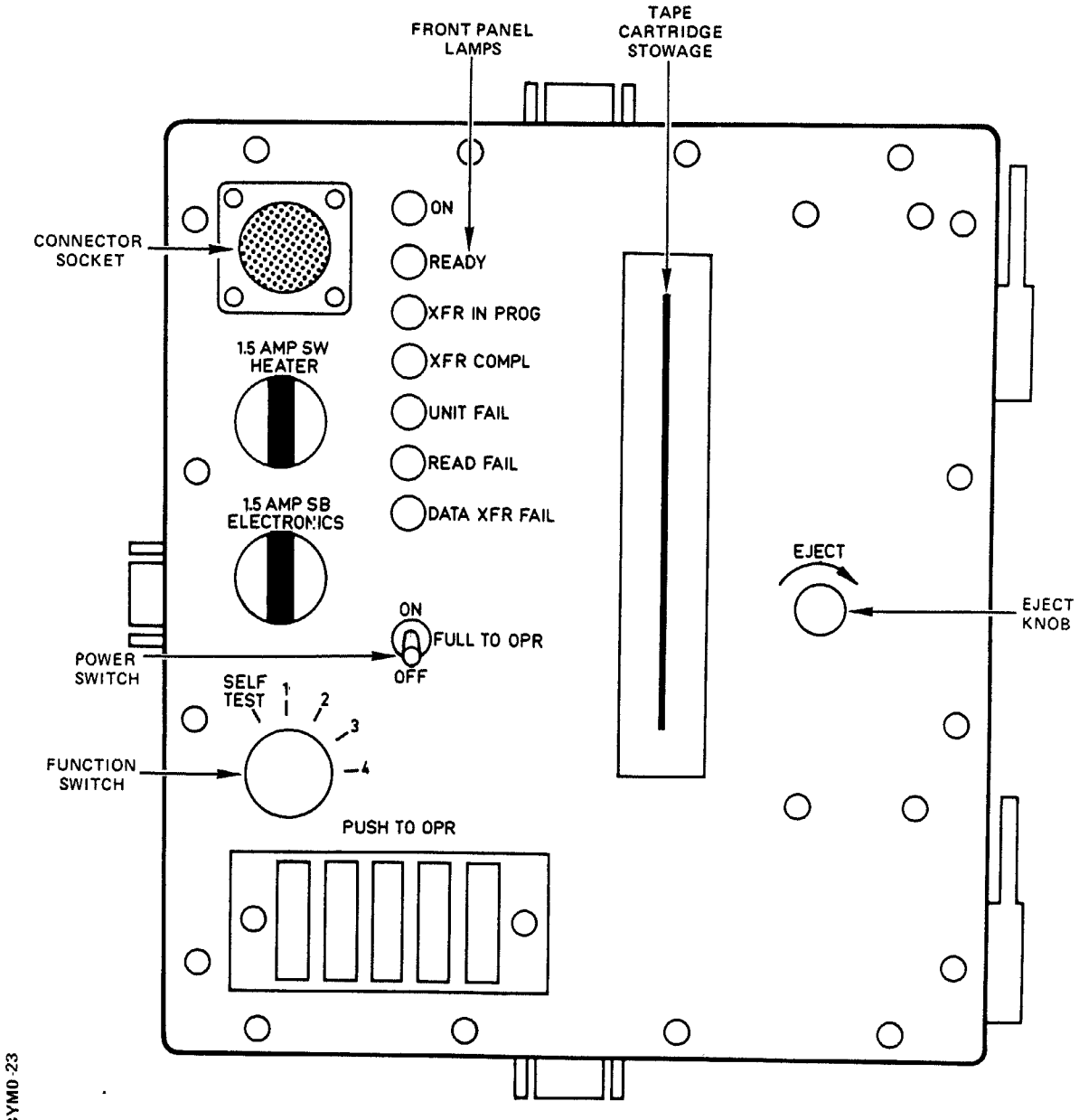
(8)FMC outputs to (1GU) CGCC
This outputs consists of a high speed ARINC 429 file output. The FMC transmits the following type of message to the (1GU) CGCC :
- Zero Fuel Weight (ZFW) (label 066)
- Zero Fuel Weight Center of Gravity (ZFWCG) (label 074).

(9)FMC outputs to AIDS (DFDAU, DMU)
FMC1 and FMC2 transmit the following data to AIDS :
- Distance to Go (label 001)
- Time to Go (label 002)
- Ground Speed (label 012)
- Center of Gravity (label 066)
- ZFW (label 074)
- Gross Weight (label 075)
- Bearing to Waypoint (label 115)
- Crosstrack Error (label 116)
- Vertical Deviation (label 117)
- Date/Flight Leg (label 260)
- Flight Number (label 261)
- Documentary Data (label 262)
- NDB Effective End Data (label 263)
- Present Position LAT (label 310)
- Present Position LONG (label 311)

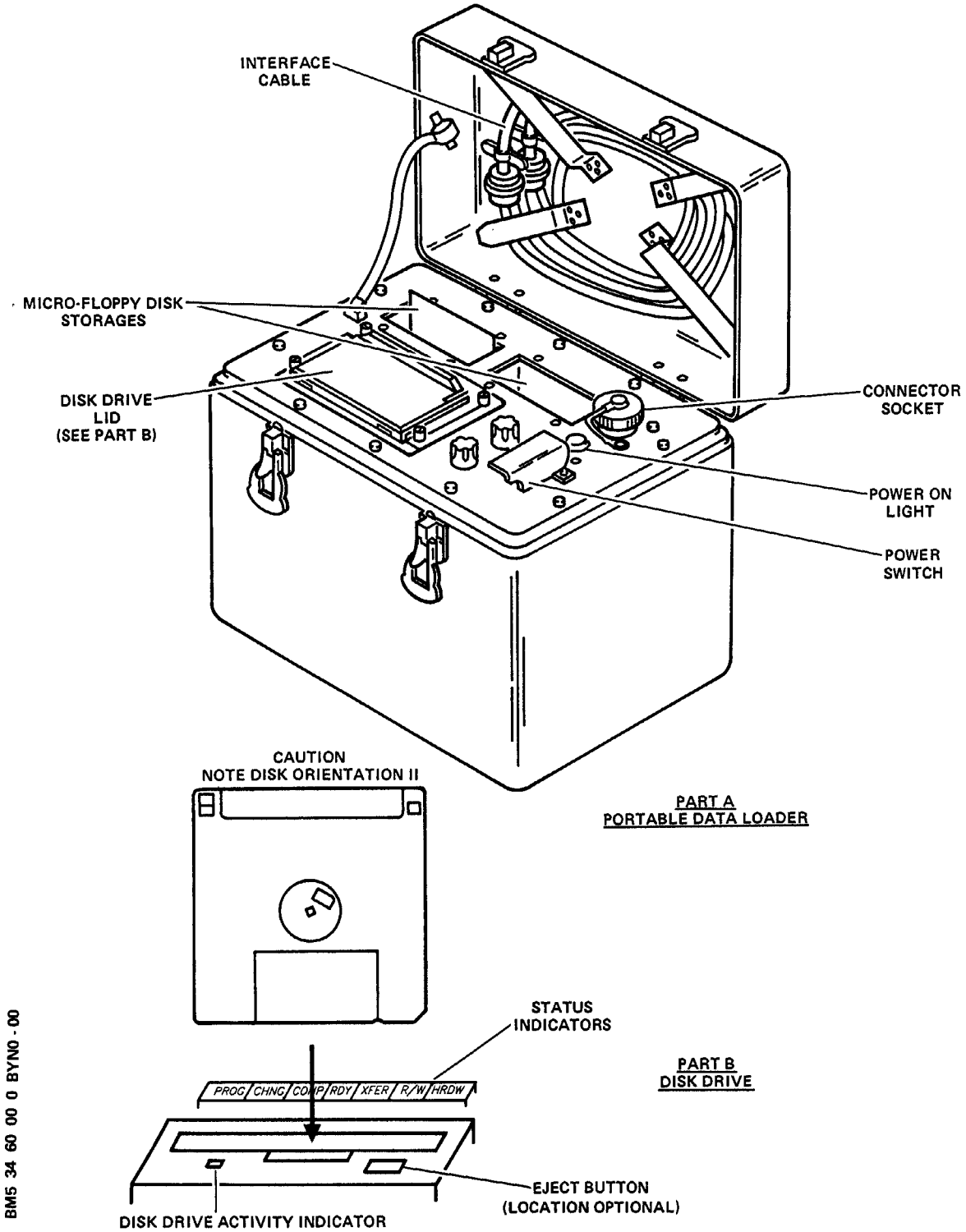
D. Data Loaders

(1)Magnetic tape data loader (Ref. Fig. 021)
The data loader for the FMC is a light weight portable entry device used to transfer data from a magnetic tape to the FMC data base.
This ARINC 603 data loader uses a low speed ARINC 429 data bus. The discretes provided through the connector reflect the function select switch positions.
The aircraft data loader interface connector provides all the signals necessary for proper operation of data loader including 115VAC 400 Hz aircraft power.
An interface cable of length of 15 feet (3.6 m) is considered as part of the data loader.

(2)Micro-floppy disk drive data loader (Ref. Fig. 022)
The data loader for the FMC is a 3.5 inch floppy disk drive system used to transfer data from diskettes to the FMC data base.
This ARINC 615 data loader uses a high speed ARINC 429 data bus. Thus, the data loader is connected to the ARINC 429 data bus through an interface cable (15 ft./3.6 m) and a special ARINC 615 to 603 adaptor.
The disk drive is protected by a lid and composed of the disk housing, an eject pushbutton, a disk drive activity indicator and seven status indicators :
- PROG : Transfer in progress
- CHNG : Change disk
- COMP : Transfer complete
- RDY : Ready
- XFER : Data transfer failure
- R/W : Read/Write error
- HRDW : Hardware malfunction



FMS - Magnetic Tape Data Loader
Figure 021



FMS - Floppy Disk Drive Data Loader
Figure 022

E. Control Display Unit (CDU)
(Ref. Fig. 023)

(1)CDU

The CDU consists of a metal housing containing a CRT module and control module, and a front panel keyboard assembly. The CRT module contains CRT circuitry, deflection amplifiers, phosphor protection circuitry and the high voltage power supply.

The control module contains the digital logic, control circuitry, and low voltage power supply.

Interconnection with the aircraft wiring system to the FMC is provided by one connector located on the rear panel of the CDU.

(2)Electronic computation

The CDU provides the crew interface with the FMC.

The unit provides the capability of not only monitoring, calling up and displaying information stored in the FMC memory, but it also has the capability to enter information and changes into the FMC through its front panel key switches.

(3)CDU output bus to FMC

Each CDU outputs data to the onside FMC according to the chosen split cockpit concept via an ARINC 429 low speed bus. The data transferred is file protocol

The CDU transmits the following types of messages to FMC.

- Power up message (label 300)
- ACK/NAK message (acknowledge/not acknowledge message (label 302)
- Button push message (label 305)
- Discrete word message (label 270)

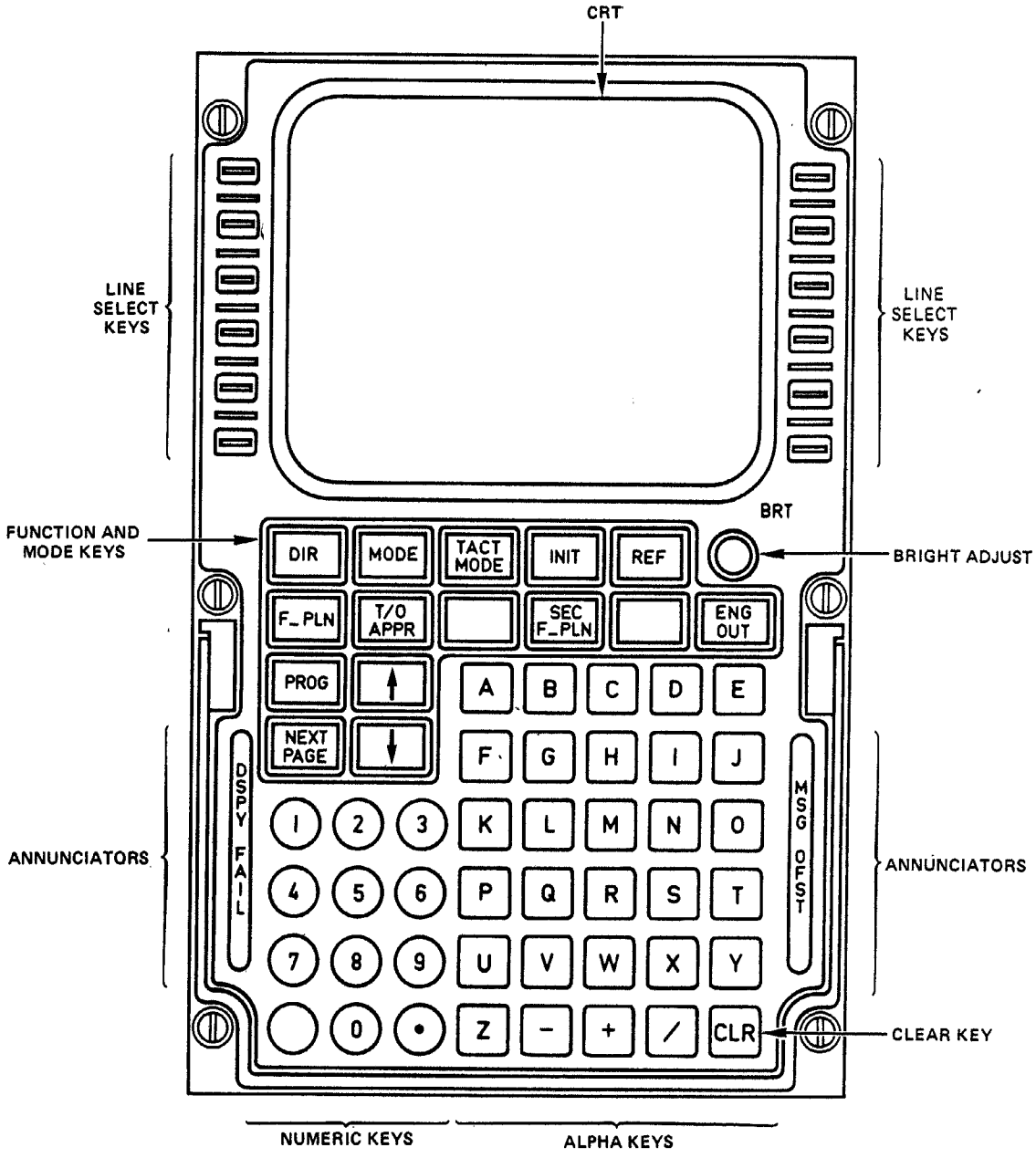
(4)CDU discrete inputs

DISCRETE	FUNCTION	
	GROUND	OPEN
Active Port	Offside	Onside
CDU Slot Identifier	CDU 2	CDU 1
FMC Fail	Good	Failed
CDU Message	Message	No Message
Lamp Test	Test On	Test Off

(5)CDU power supply

The CDU utilizes Aircraft Primary power 115VAC 400Hz and provides nine regulated dc output supply voltages. The internal power supply provides input rectification, filtering, energy storage, switching regulator, switching power bridge, overcurrent detection/shutdown, overvoltage monitor shutdown, phosphor protect voltage and power reset.

The 28VDC is not used as a power input but as logic signal for the BRT/DIM function of the CDU annunciators.



NOTE TWO INTEGRAL AUTOMATIC LIGHT SENSORS ARE LOCATED IN THE UPPER CORNERS OF THE KEYBOARD ASSEMBLY ABOVE THE LINE SELECT KEYS.

BM5 34 60 00 0 BZM0 24 19
DM5

Control Display Unit
Figure 023

1. Reason for the Job
FMCs data base loading procedure.

R NOTE : Record the PERF FACTOR value before starting loading procedure.

NOTE : In order to save time during the FMCs data base loading, the procedure should be performed as follows :

A. NAV Data Base Loading
Loading of one FMC through data loader.

B. NAV Data Base Cross-Loading
Cross loading of opposite FMC 1(2) to the other.

2. Equipment and Materials

ITEM	DESIGNATION
A. QNTX2760A	Flight Management System Loader - QUANTEX
B. 964-0400-0XX	Flight Management System Loader - SUNDSTRAND
C. 704-2221-001	615/603 ARINC adaptor cable - SUNDSTRAND
Reference Procedure - 24-41-00, P. Block 301	AC External Power Control

NOTE : FMC SUNDSTRAND data loader is used instead of QANTEX, only when data capacity is above 330 Kwords.

3. Procedure

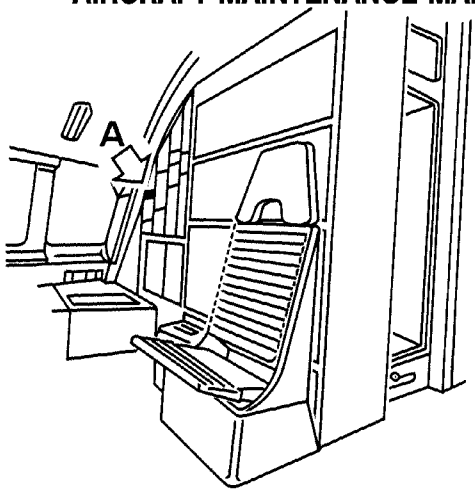
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

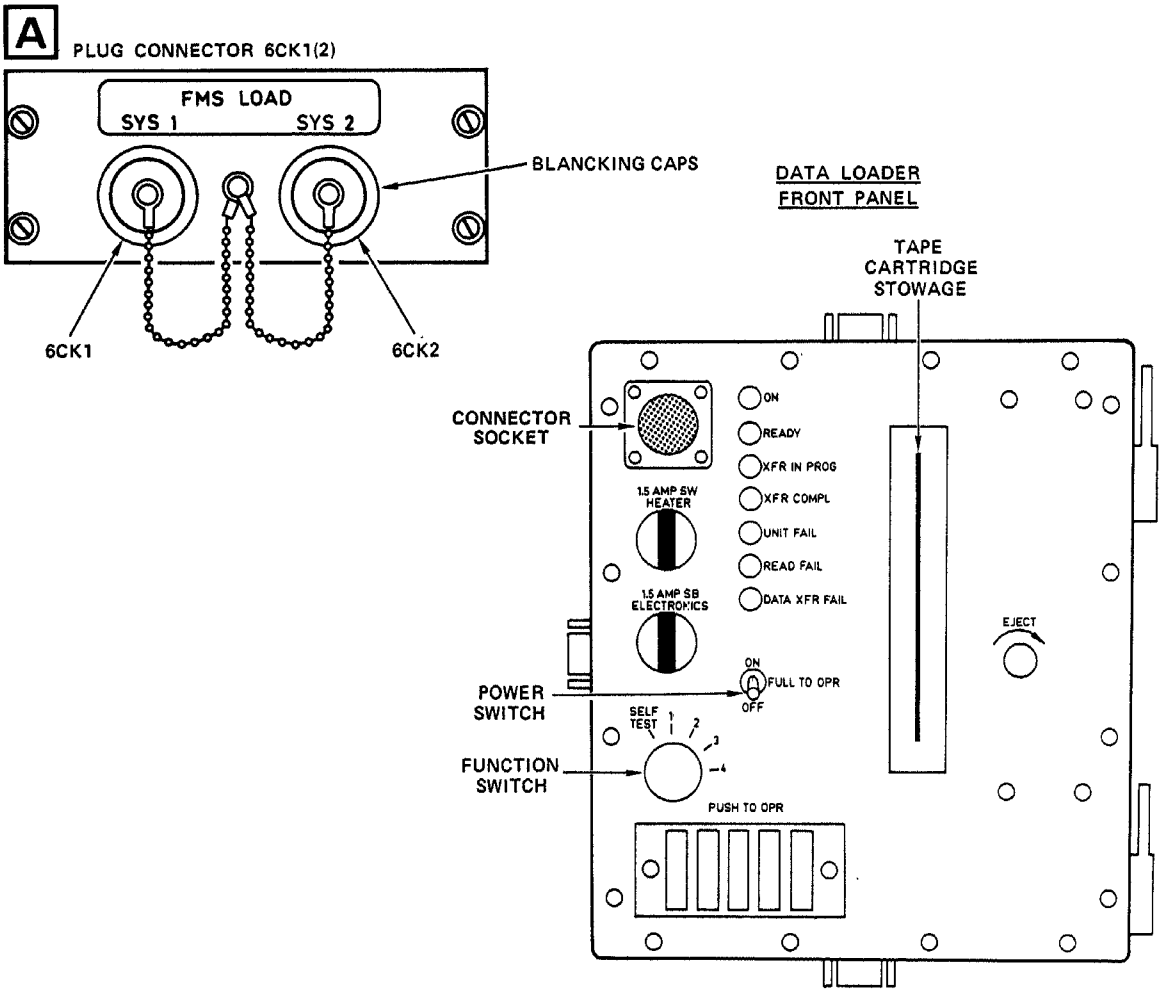
A. Job Set-Up
(1)Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(2)Make certain that electronics racks ventilation is correct.
(3)Close overhead panel circuit breakers.
(4)Close L/G GEAR PROX DET and RELAYS circuit breakers on panel 133VU (aircraft in ground configuration).
NOTE : The procedure described below concerns FMC 1. For FMC 2 which is identical, refer to information between parentheses.

B. Operation
(1)NAV data base loading with tape Cartridge Data Loader
(Ref. Fig. 301)

ACTION	RESULT
1. On overhead circuit breaker panel 21VU, open FMS SYS1(2) SUPPLY circuit breaker 4CK1(2) and FMS SYS1(2) DIM circuit breaker 5CK1(2) (location 101/J11 to J14)	
2. On data loader, check that power	

ACTION	RESULT
switch is in OFF position and that function switch is in position 1. - connect loom to data loader socket.	
3. On rear panel 120VU, remove blanking caps and connect data loader loom to FMS LOAD SYS1(2) plug 6CK1(2).	
4. On panel 21VU, close circuit breakers 4CK1(2) and 5CK1(2).	On FMS CDU1(2) check that FMC FAIL is displayed in CRT center section 10 seconds later.
5. On data loader : - insert tape cartridge - place power switch in ON position	On data loader check that the 7 lights come on and remain on for 3 seconds approx. Test cartridge : - tape winds and rewinds, reproducing head on position; operating time : 1 to 2 minutes approx. - READY indicator light comes on - XFR IN PROG indicator light comes on - approximately 25 minutes later, XFR IN PROG indicator light goes off - XFR COMPL indicator light comes on
- place power switch in OFF position - eject the cartridge - place function switch in SELF TEST position	
6. On panel 21VU, open circuit breakers 4CK1(2) and 5CK1(2).	
7. On rear panel 120VU disconnect data loader loom from FMS LOAD SYS1(2) plug 6CK1(2) and install blanking caps.	
8. On panel 21VU, close circuit breakers 4CK1(2) and 5CK1(2)	
9. On A/C STATUS page : - Check updating of the data base (date applicability)	On FMS CDU1(2) - A/C STATUS page is displayed.





BM5 34 60 00 3 AAJ0-00

FMS Load (with Tape Cartridge) - Location
Figure 301

R

(2)NAV data base loading with floppy disk Data Loader
(Ref. Fig. 302)

ACTION	RESULT
1. On overhead circuit breaker panel 21 VU, open FMS SYS1 (2) SUPPLY circuit breaker 4 CK1 (2) and FMS SYS1 (2) DIM circuit breaker 5CK1 (2) (location 101/J11 to J14).	
2. On data loader, check that power switch is in OFF position. - connect loom to data loader socket; then connect "special" adaptor.	
**ON A/C 101-200,	
Post SB 34-2151 For A/C 101-200,	

ACTION	RESULT
1. On overhead circuit breaker panel 21 VU, open FMS SYS1 (2) SUPPLY circuit breaker 4 CK1 (2) and FMS SYS1 (2) DIM circuit breaker 5CK1 (2) (location 101/J11 to J14).	
2. On data loader, check that power switch is in OFF position. - connect "special" adaptor.	
**ON A/C ALL	
3. On rear panel 120VU, remove blanking caps and connect 615/603 ARINC adaptor loader loom to FMS LOAD SYS1 (2) plug 6CK1 (2).	
4. On panel 21VU, close sircuit breakers 4CK1 (2) and 5CK1 (2).	On FMS CDU1 (2) check that FMC FAIL or FMC UNAVAILABLE is displayed in CRT center

ACTION	RESULT
	section 10 seconds later.
5. On data loader : - place power switch in **ON** position. - insert the floppy disk.	On data loader check that all lights flash. When flashing stops, the **RDY** and **PROG** indicator lights come on. Between 10 and 40 minutes later, the **RDY** and **PROG** lights go off and the **COMP** indicator light comes on.
- eject the floppy disk. - place power switch in **OFF** position.	
6. On panel 21VU, open circuit breakers 4CK1 (2) and 5CK1 (2)	
7. On lateral panel 120VU, disconnect "special" adaptor data loader loom to **FMS LOAD SYS1** (2) plug 6CK1 (2) and install blanking caps.	
8. On panel 21VU, close circuit breakers 4CK1 (2) and 5CK1 (2).	
9. On **A/C STATUS** page : - check updating of the data base (date applicability).	On **FMS CDU1** (2) : - **A/C STATUS** page is displayed.
(3)**NAV** data base cross loading (Ref. Fig. 303)	

ACTION	RESULT
On both **CDUs** 1. Press **REF CDU** pushbutton	On both **CDUs** - **REF INDEX** page is displayed.
2. Press LS key adjacent to **MAINT LINE**	- **MAINT** page is displayed.
3. Enter **ARM** through alphanumeric keyboard	- **ARM** is displayed in the scratchpad line.

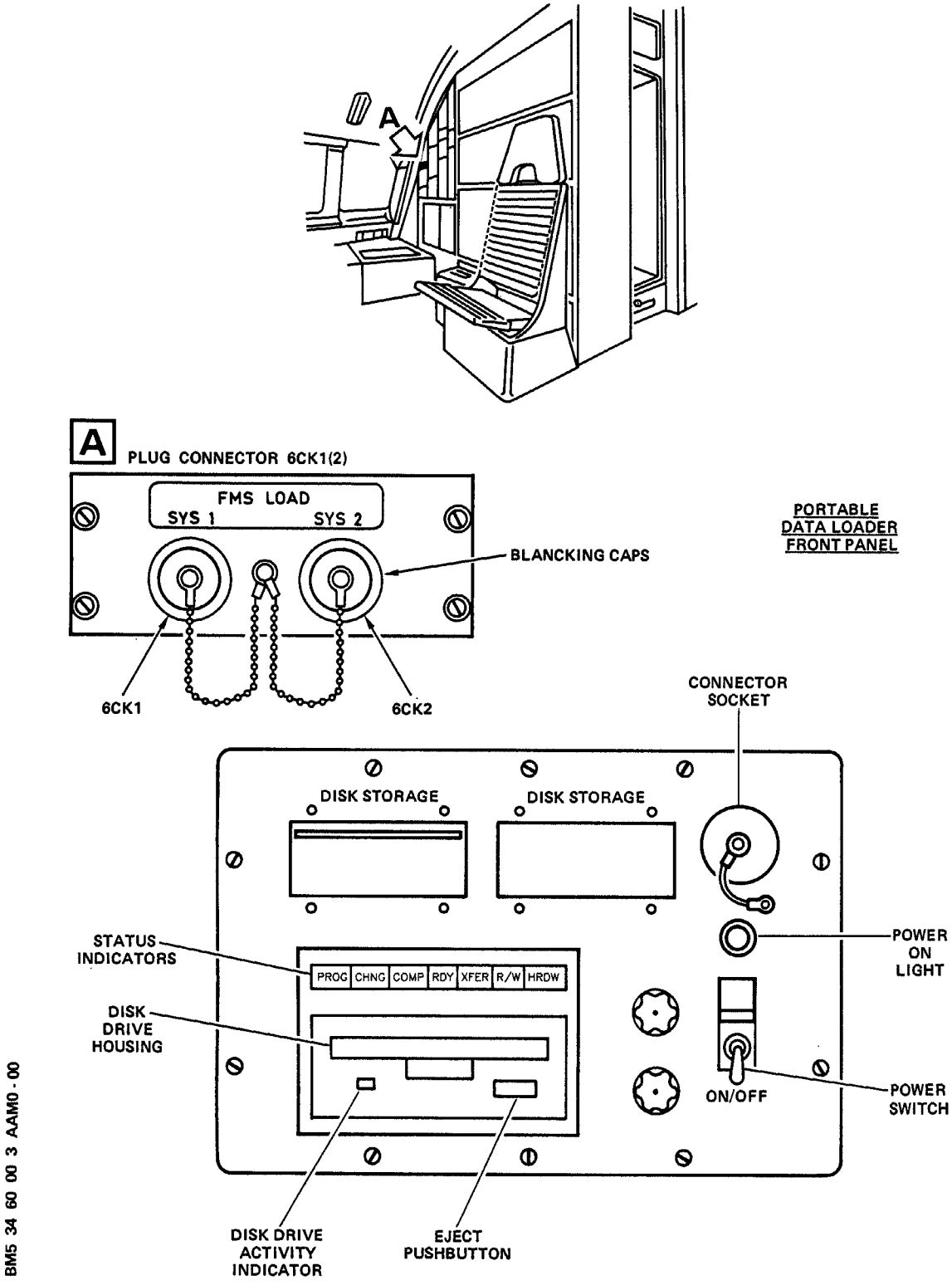
ACTION	RESULT
4. Press LS key adjacent to parentheses (key 5R) NOTE : The correct sequence to load NDB's with the cross load feature is first selecting the TRANSMIT FMC-CDU and second the RECEIVE FMC-CDU. The opposite sequence is incorrect and not guaranteed to work.	- ARM is displayed. The parentheses disappear.
5. On CDU of FMC already loaded (transmitting FMC) - press LS key adjacent to TRANSMIT line	On corresponding CDU - RECEIVE disappears.
6. On CDU of FMC to be loaded (receiving FMC) - press LS key adjacent to RECEIVE line	On corresponding CDU - TRANSMIT disappears and PLEASE WAIT appears on MAINT page then the CDU goes blank except for the text FMC FAIL, then PLEASE WAIT appears on the MAINT page. On CDU of the transmitting FMC - TRANSFER IN PROGRESS appears.
7. On both FMS CDUs - wait for transfer completion (about 5 minutes) - press CLR key NOTE : For the following items, before any action, it is necessary to wait 1 minute after deletion of FMC FAIL message.	On both FMS CDUs - MAINT page appears with scratchpad displaying TRANSFER COMPLETE. - TRANSFER COMPLETE disappears.
8. On A/C status page - check updating of the data base (date applicability)	- Same data base on both FMS CDUs.
9. Press REF CDU pushbutton	- REF INDEX page is displayed.

ACTION	RESULT
10. Press LS key adjacent to MAINT line	- MAINT page is displayed.
11. Press line key adjacent to SELF TEST line	- PASS is displayed as long as MAINTENANCE page is displayed.

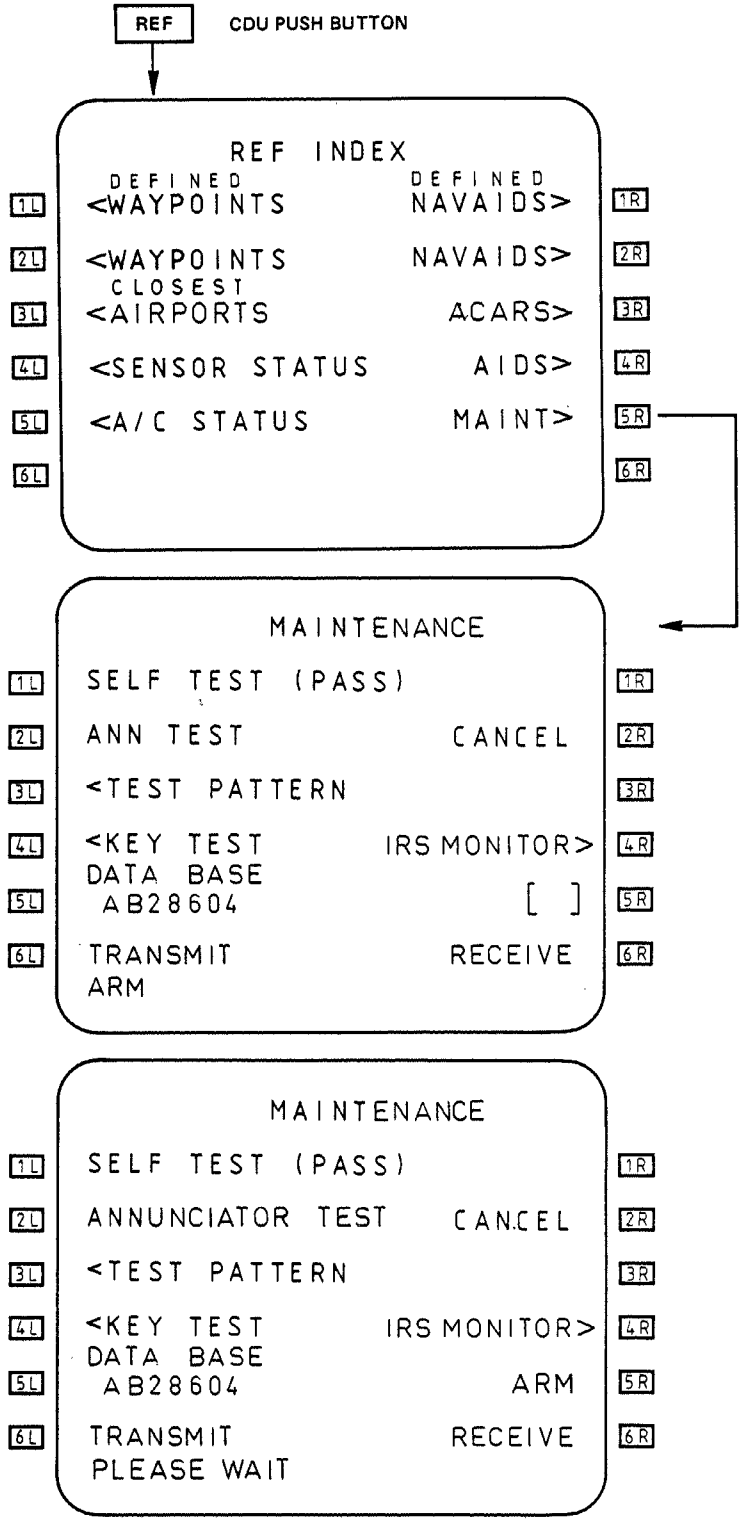
NOTE : While FMS SELF TEST is running on one side, the offside CDU displays INDEPENDENT OPERATION. Once the test is passed, PLEASE WAIT is displayed on both CDUs for a few seconds while both FMCs re-synchronize. After the resynchronization succeeds, normal configuration is automatically restored on both CDUs.

C. Test
(1) For NAV data base loading
On FMS CDU 1(2) check updating of the data base (date applicability).

D. CLose-Up
(1) De-energize the aircraft electrical network.
(2) Restore system and aircraft to normal operating condition.



FMS Load with Floppy Disk - Location
Figure 302



BM5 34 60 00 3 ABJ0 00

Access to Maintenance Page
Figure 303

R

1. Operational Test

A. FMS Test

(1)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(2)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Close overhead panel circuit breakers particularly those associated with FMS (NAV and RADIO-NAV).

4 (Aircraft in ground configuration). Close L/G PROX DET and RELAYS C/Bs on panel 133VU.

NOTE : The test described below concerns FMC1. For FMC2, refer to information between parentheses.

(b)Test

ACTION	RESULT
	After warm-up time of CRT, check on center pedestal that A/C STATUS page is displayed on FMS CDU1 (2).
On CDU1 (2)	On CDU1 (2)
1. Vary brightness using BRT knob	Check that CRT brightness increases and decreases
2. On overhead panel place ANN LT switch in TEST position.	- DSPY, FAIL, MSG and OFST annunciators come on.
3. Place ANN LT switch in BRT position	- Annunciators above go off.
4. Successively press MODE keys except NEXT PAGE, ENG OUT, SEC F-PLN	- Check that corresponding pages are displayed.
5. Press REF key	- REF INDEX page is displayed.
6. Press LS key adjacent to A/C STATUS line	- Check that A/C STATUS page is displayed and the LATERAL

ACTION	RESULT
	ONLY message is not displayed in the engine data field.
7. Press REF key	- REF INDEX page is displayed.
8. Press LS key adjacent to MAINT line	- MAINT page is displayed.
9. Press LS key adjacent to SELF TEST line.	- Self test develops : A few seconds later, PASS is displayed adjacent to SELF TEST.
NOTE : While FMS SELF TEST is running on one side, the offside CDU displays INDEPENDENT OPERATION. Once the test is passed, PLEASE WAIT is displayed on both CDUs for a few seconds while both FMCs re-synchronize. After the re-synchronization succeeds, normal configuration is automatically restored on both CDUs.	
10. Press key adjacent to ANN TEST line	- DSPY, FAIL, MSG and OFST annunciators come on on CDU. CANCEL is displayed in the right line.
11. Press key adjacent to CANCEL line	- DSPY, FAIL, MSG and OFST annunciators go off. On CRT, CANCEL disappears.
12. Press key adjacent to TEST PATTERN	- CDU TEST PATTERN page is displayed.
13. Press key adjacent to RETURN.	- MAINT page is called up again.
14. Press key adjacent to KEY TEST.	- PRESS LS KEY and an arrow are displayed.
15. Press key indicated by the arrow then follow instructions displayed on CDU CRT.	- At the end of sequence MAINT page is displayed.
16. Press REF key.	- REF INDEX page is displayed
17. Press key adjacent to SENSOR STATUS line.	- SENSOR STATUS page is displayed.
18. Press REF key.	- REF INDEX page is displayed.

(c)Close-up

1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Restore system and aircraft to normal operating condition.

B. Alignment of IRS1, 2 and 3 via CDUs through FMC1 (2)

(1)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(2)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT, MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

1 Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Make certain that electronics racks ventilation is correct.

3 Close overhead panel circuit breakers particularly those associated with FMS and NAVIGATION.

4 (Aircraft in ground configuration). Close L/G GEAR PROX DET and RELAYS C/Bs on panel 133VU.

NOTE : The test described below concerns FMC1. For FMC2, refer to information between parentheses.

(b)IRS alignment

	ACTION	RESULT
		After warm-up time of CRT, check on center pedestal that A/C STATUS page is displayed on FMS CDU1(2).
	1. On overhead panel, place MSU1, 2 and 3 mode selector switch in NAV position	On MSU1, 2, 3 - ALIGN MODE annunciator comes on - BAT OPER annunciator comes on then goes off a few seconds later.
R	2. On overhead panel, on ISDU, place SYS selector switch in position 1 and DSPL selector switch in HDG/STS position	03 10 is displayed on right display of ISDU.
	3. On FMS CDU 1(2) : press INIT key	On FMS CDU 1(2) : - INIT DATA page is displayed
	4. Enter a company route : example 50 (LFBO) on FMS CDU 1(2)	50 is displayed in the scratchpad line, in CRT lower section.
	5. Press key adjacent to CO RTE	50 is displayed below CO RTE and goes off from scratchpad line. LAT and LONG lines are filled up.
	6. Wait until ALIGN IRS is displayed on	Check that on left ECAM display

	ACTION	RESULT
	CDU right line.	unit in MEMO mode IRS IN ALIGN message is displayed.
	7. Press right key adjacent to ALIGN IRS line on CDU	On CDU ALIGN IRS disappears. On left ECAM display unit IRS IN ALIGN message disappears when alignment phase is completed.
R	8. On ISDU, place DSPL selector switch in PPOS position and select system selector switch successively for each IRS.	Check that ISDU left and right displays show same position data as FMS CDU
	9. On ISDU, place DSPL selector switch	Check that alignment status appears
R	in HDG/STS position	on right display of ISDU (O = SYS in NAV)
	10. Wait until ALIGN MODE annunciators go off on the MSUs	A/C attitude is displayed on both PFDs. A/C heading is displayed on both NDs.

(c) Close-up
1 On MSU 1, 2, 3 place mode selector switch in OFF position.
2 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
3 Restore system and aircraft to normal operating condition.

1. Aircraft Power Supply

A. Primary Power (115VAC/400Hz)

(Ref. Fig. 002)
(Ref. Fig. 001)
The FMCS utilizes 115VAC/400 Hz as primary power as shown in the inter-wiring diagram.
Power for FMC1, CDU1 and the data loader (via connector 6CK1) is through common circuit breaker 4CK1.
Similarly, power for FMC2 CDU2 and the data loader (via connector 6CK2) is through common circuit breaker 4CK2.
Normal busbar 100XP (via 105XP) supplies power to FMCS1 and normal busbar 200XP (via 205XP) supplies power to FMCS2.
For the FMC the maximum continuous current will not exceed 1.75 amperes, while the maximum start up current (to speed up the disc) will not exceed 2.5 amperes.
The corresponding maximum value for the CDU is 0.8 amperes (with the 4 annunciators on and the CDU keyboard background lighting on).
The 5VAC is utilized for the CDU key background lighting via busbar 103XP and circuit breaker 1LF.

B. CDU BRT/DIM (28VDC) (Ref. Fig. 003)

The 28VDC is not used as a power input but as a logic signal. It is used for the BRT/DIM function of the CDU and to illuminate the CDU annunciators.
The 28VDC is received by CDU 1 on pin 27 from busbar 110PP via circuit breaker 5CK1, by CDU 2 from busbar 111PP via circuit breaker 5CK2.
The TEST/BRT/DIM three-position switch on overhead panel 436VU allows the 4 CDU annunciators to be tested and dimmed.

C. CDU Keyboard Lighting

(Ref. Fig. 004)
The CDU key background lighting requires a variable 5 VAC voltage entry which is received by the CDU pins 28 (high) and 29 (low).
The 115VAC is taken from busbar 103XP. If circuit breaker 1LF is pushed the LF circuitry (367LF) is supplied with 115V. Then the background lighting of both CDUs together with Captain and center instrument panel can be dimmed via CAPT & CTR INSTL LT corresponding knob which is located in 419VU.

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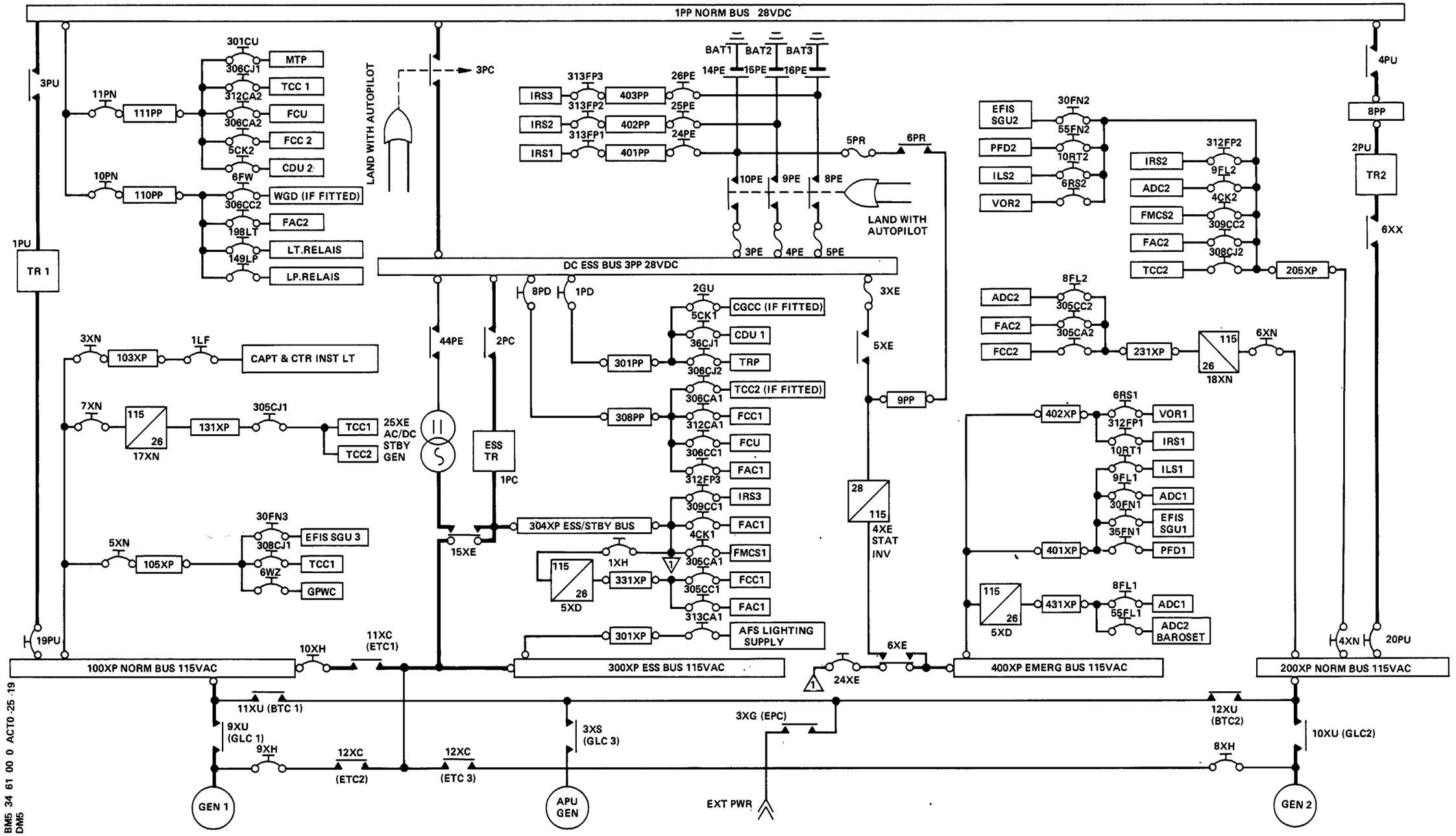
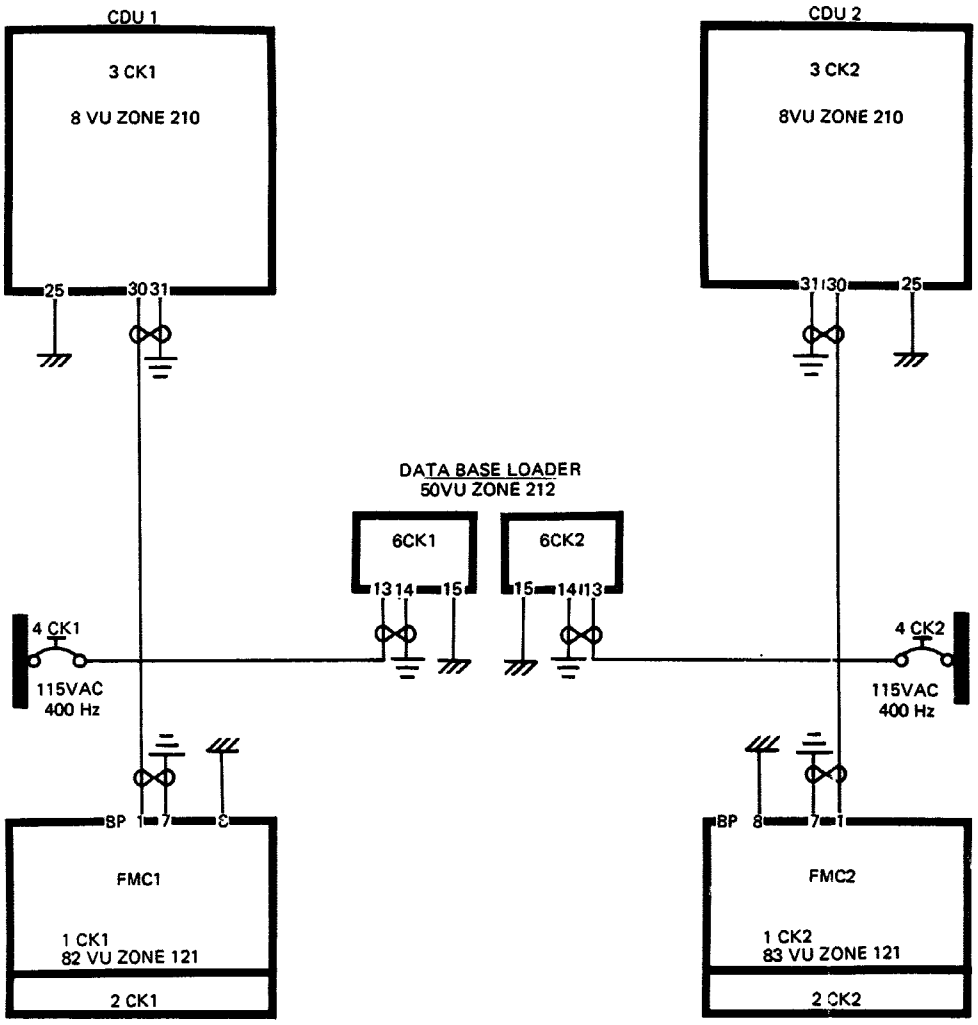
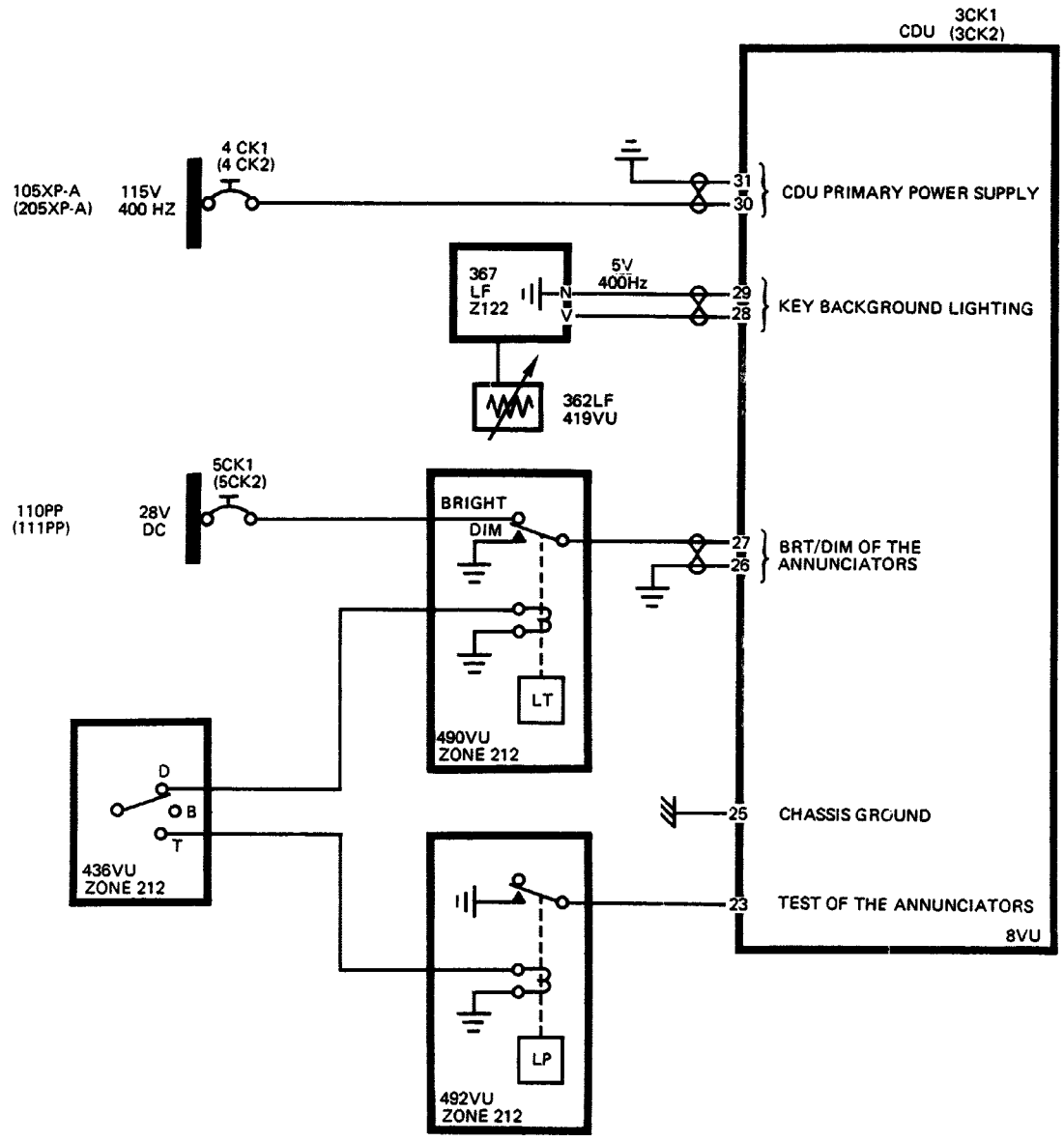


Electrical Power Supply of FMS and Peripheral Systems
Figure 001



BMS 34 61 00 0 AAMO

FMCS Primary Power Supply
Figure 002



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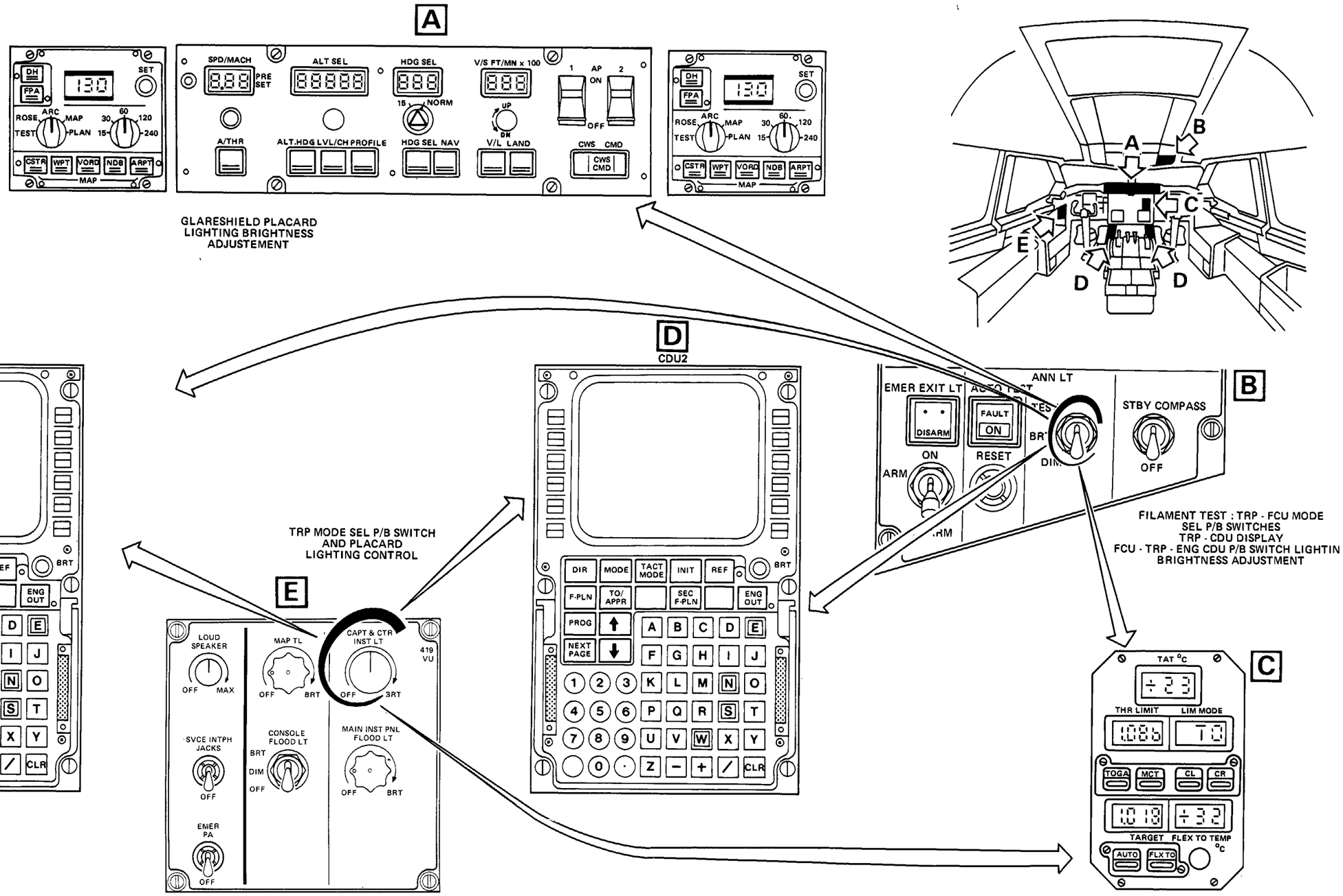
CDU Power Supply, BRT/DIM Control and Key Legend Lighting
Figure 003



FMS Lighting Controls
Figure 004

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D. Input Power Supply Characteristics
The input power characteristics as received by the FMC, CDU and Data Loader are summarized in the table below

TABLE 1
POWER CHARACTERISTICS AT FMCS PINS

Power Quality Characteristics	Power Quality Limits Maintained at the FMC and CDU by Aircraft Electrical System
Single phase voltage PRIMARY POWER	FMC : 107.5 - 120VAC 400 ± 20Hz CDU : 107.5 - 120VAC 400 ± 20Hz
Single phase voltage keyboard lighting	CDU : 4-5.5VAC 400 ± 20Hz
Annunciator dimming	CDU : +28 ± 1.5VDC

1. FMS Modes of Operation

A. Definitions

(1) Dual FMS operation

Dual FMS operation is the basic mode of operation when both FMSs are operating together, one as the master and one as the slave. Both FMSs process pilot input information in the same order and sequence through legs of the flight plan at the same time. The flight plans and all pilot entered information are identical in both FMS.

The master FMS is responsible for ensuring the two systems are operating together. If a discrepancy appears, the FMS enter the independent operation mode.

(2) Independent FMS operation

The independent mode of operation occurs when the two FMSs operate independently. Both FMSs assume their own responsibility as the master, but monitoring of the slave, as in the dual mode, is not necessary. Under the independent mode, each FMC processes button pushes from its onside CDU only.

For the system to resume the dual mode operation from the independent configuration, a long-term power-up is necessary. This requires the FMC to listen (via the ISB) for a long-term power-up from the other system.

When the FMS enters the independent mode of operation, message independent operation is displayed.

The message is cleared on leaving the independent mode of operation.

NOTE : ISB = Inter System Bus.

B. Master/Slave Concept

(1) Overview

The basic FMS configuration in the aircraft is two FMCs and two CDUs. These two systems are independent in their calculations, but there are certain functions that are controlled by one FMC. The mechanism used to do this is a master/slave arrangement. The master FMC controls the critical functions and the slave FMC obeys the master FMC commands.

The master FMC is determined by two discretes from the FCU (FCC1 and FCC2) that indicate which FCC is in command. The master FMC is the FMC on the side of the FCC that is in command. If the FCC in command is changed the transfer to Master is done ensuring no flight plan modifications are missed and no pushbutton is processed in one FMC and not in the other FMC. If, at any time, both discretes are low or both discretes are high, the FMC considers the FCU as failed and the left FMC is the master.

(2) Duties controlled by the master FMC

The master FMC controls the following system functions and commands the slave to do these functions.

Function 1 : Initiate Parameter change. The active state of value of the following parameters is indicated to the slave FMC at every change of parameter state :
Flight phase
Active lateral leg
Pseudo waypoint sequenced

Available situation Mode
Engine start
CLR ALT
Maximum altitude

Function 2 : Determine the CDU button push order - All button pushes (except alphanumeric entries(see note (a)) from both CDUs are processed in the same order in both FMCs, and at no time will one FMC be processing a different button push than the other FMC. This is accomplished by sending all slave FMC button pushes to the master FMC via the ISB. The master then has all its own and the slave's CDU button pushes in one queue. When the master begins processing a button push (see note (b)), that button push is sent (via ISB) to the slave for the slave to process. Before another button push is processed, the slave and master must both be through processing the previous button push. If the master (after sending a button push to the slave) does not receive a done indication from the slave within 1.0 seconds after the master is through processing the button push, the master will retransmit the button push (see note (c)). After 5 retransmits, the FMS goes to independent operation.

NOTES :

(a) Alphanumeric entries need not be processed in the same manner as other keys. However, they must be sent to the offside FMC to be included in any subsequent processing.

(b) Processing a button push means executing the software to the extent necessary to process another button push. For example, if there is a lateral flight plan change, the FMC must complete the change before processing the next button push, because the meaning of a button push may be different if the flight plan is different. However, the FMC processes the next button push before all performance calculations are complete, because the meaning of a button push does not depend on the results of the performance calculation.

(c) The slave FMC must ensure that it does not process a button push more than once because of the retransmits.

Function 3 : Data comparison.
The following parameters are exchanged with the slave FMC for comparison at initialization and for steady state dual mode.

Initialization

	Test requirement	Failure response
NAV data base ident	same	Independent mode
Operational program ident	same	Independent mode
Engine type program pins 24	same	Independent mode
Location SDI program pins	opposite	Independent mode

Steady state

	Frequency	Test requirement	Failure response
FLight plan	Every F-PLN change after power transient	same	Note 1
CDU entry sequence number	Every button push	same	Note 1
Present position	1HZ	<5 NM. diff.	Note 5
	1HZ	<10NM. diff.	
FCU Status (Note 4)	1HZ	same	Note 2
GMT (clock 1 clock 2)	1HZ	<2 mn. diff.	Note 3
GROSS WEIGHT	1HZ	<1 ton. diff.	Note 6

Note 1 : After a long term power transient, each miscompare of either F. PLAN or CDU entry sequence number causes a forced synchronization of data between FMCs. After 5 miscompares the FMCs go to independent mode.

Note 2 : 9 consecutive comparison failures are required to go to independent mode.

Note 3 : For every pass-to-fail transition the CDU scratchpad displays message "CLOCK DO NOT MATCH" The message is cleared on a fail-to-pass transition.

Note 4 : FCU status is determined by the external sensor monitoring logic.

Note 5 : After 9 consecutive comparison failures, the CDU scratchpad displays message "FMC POSITION MISMATCH" which is cleared if the difference becomes less than 3NM.

R Note 6 : After 9 consecutive comparison failures, the

	Frequency	Test requirement	Failure response
R		CDU displays message "GROSS WEIGHT MISMATCH".	
R		This message is automatically cleared if the	
R		difference becomes less than 0.5 ton.	

(3)Duties for the slave FMC
The slave FMC performs the following :
(a)Monitors the parameter changes of the master FMC and ensures that its own parameter state is the same.
(b)Receives button pushes from the onside CDU and tranfers these button pushes to the master FMC via the ISB. When a button push is received from the master FMC, the slave must process the button push and notify the master FMC when done.
(c)When a comparison is initiated by the master FMC, the slave FMC does the comparison and indicates the results to the master FMC.

C. Dual Operation of CDUs Rules
When in the dual mode of operation, both CDUs act independently as follows :
(1)Button pushes on either CDU meet timing requirements.
(2)Both CDUs can display separate display pages.
(3)For CDUs displaying the same page, page entries are the same :
(a)When both CDUs have the same page displayed, any entry on one CDU is displayed on the other CDU. This applies to all data field entries but not scratchpad entries.
(b)The NAV AID, WAYPOINT, NEW NAVAID, and NEW WAYPOINT pages are exceptions to rule (a), in which they operate independently at all times :
1 A data base access via the NAV AID or WAYPOINT page is only reflected on the CDU where entry is made. In particular, if one CDU is on the NAVAID page displaying a data base navaid, and the other CDU accesses the NAVAID page, the second CDU will display the tuned navaids.
2 The NEW NAVAID or NEW WAYPOINT data entries are only reflected on the CDU where entry is made. The new navaid or waypoint is only recognized by the dual system when it has been entered (via the ENTER prompt) into the data base. It is then accessible on both CDUs via the DEFINED NAVAID and DEFINED WAYPOINT pages as appropriate.
(c)If a non-unique waypoint or navaid identifier is entered, then the DUPLICATE NAMES page is displayed, only on the CDU where entry is made.
(d)When both CDUs are displaying the same page, vertical or horizontal slewing (either by NEXT PAGE key or NEXT/PREV prompts) of the page on one CDU is not reflected on the other CDU. LAT/LONG slewing on the INIT Page A is regarded as a data entry and rule (a) is applied.
(4)Each FMC does its calculations separately with different input data (split cockpit concept). Therefore the two FMCs detect the need for various messages at slightly different times and possibly one detects the need for a message and the second one does not. Messages are displayed on the CDU only when they are detected by the onside FMC. An exception to

this is if a message is a direct result of a CDU button push (E.G. : ENTRY OUT OF RANGE) the message is only displayed on the CDU where the button was pushed. Also, messages are only cleared within the onside FMC when they are cleared on the CDU.

(5)When in the dual mode of operation, button pushes on either CDU are processed in both FMCs in the same order.

(6)Only one F-PLN revision can be implemented at a given time. Therefore, if a F-PLN revision page is displayed on both CDUs and the LS key alongside the INSERT prompt is pressed on one CDU, then both CDUs revert to the F-PLN page. Any incomplete revisions are deleted

(7)The COPY ACTIVE and ACTIVATE SEC functions may be performed via one CDU while the other CDU is displaying a F-PLN page, the DIR TO page or a SEC F-PLN page. The following rules define the resulting display on the other CDU.

(a)If either the F-PLN A, F-PLN B or DIR TO page is displayed and

1 the ACTIVATE SEC function is performed then the respective page reappears with the FROM waypoint align with 1L

2 the COPY ACTIVE function is performed, then the page remains unchanged

(b)If either the SEC F-PLN A or SEC F-PLN B page is displayed and :

1 the ACTIVATE SEC function is performed, then the respective page reappears with the FROM waypoint in 1L.

2 the COPY ACTIVE function is performed, then the respective page reappears with the FROM waypoint in 1L.

(8)A flight plan may be initialized via one CDU while it is being displayed on the other CDU. The following rules define the resulting display on the other CDU.

If either the F-PLN A, F-PLN B or DIR TO page is displayed and the active flight plan is initialized then the respective page reappears with the FROM waypoint aligned with 1L.

If either the SEC F-PLN A or SEC F-PLN B page is displayed and the secondary flight plan is initialized then the respective page reappears with the FROM waypoint in 1L.

D. Interfaces in Case of Independent Mode of Operation

When the FMS is in the independent mode of operation, the sensors are used as in the dual mode of operation, unless data must be sent across the ISB. The following discusses those sensors that operate differently in the independent mode than they do in dual mode.

- FAC : If a failure occurs in one FAC, the onside FMC cannot get information from the offside FAC across the ISB. Therefore, the onside FMC has no valid FAC data.
- DME : The offside DME-displayed navaid frequency and DME distance must be sent out on the EFIS bus and displayed on the CDU PROG page, even when in independent mode of operation.
- VOR : The offside VOR (if selected for display) navaid IDENT and frequency must be displayed on the CDU even in independent mode of operation.
- CDU : In the independent mode of operation, each FMC listens only to its onside CDU. If either CDU goes invalid, the onside FMC does not receive valid CDU data.

- CLOCK : Each FMC gets data from only its onside CLOCK. If one CLOCK is invalid, that onside FMC does not receive valid CLOCK data.

E. Dual System Synchronization

At certain times it is necessary for the FMS to resynchronize. When resynchronization occurs, the master FMC sends sync data across the ISB to the slave FMC which uses the sync data to reinitialize itself. Resynchronization does not cause disengagement of either NAV or PROF mode. While the sync. data is being transferred across the ISB, both CDU scratchpads display message "PLEASE WAIT" to caution the pilot that button pushes are not accepted on either CDU. The message is cleared when synchronization is completed.

The sync data that must be transferred across the ISB include the following :

Flight plan definition - This includes the defining elements. The predicted elements need not be sent.

Any data input by the pilot via the CDU.

State variables for all filters and control laws.

Present CDU pages being displayed on both CDUs.

All dynamic variables within the FMC.

2. CDU Operational Use

A. General

(1)Introduction

This operational CDU description is related to aircraft fitted with dual FMS option.

(2)Summary of FMS functions

In brief, the system operates as follows with the possibility to manage two flight plans (one active, one secondary) :

(a)On ground (Preflight Phase)

- After a pilot insertion of the route to be flown, either by a Company route or airports of departure and destination, the FMS extracts the necessary data from the data base and assembles the F.PLN and the pilot can display it.
- The FMS then has the possibility to provide latitude and longitude to align the IRS's.
- After insertion of necessary parameters related to performance (CRZ altitude from data base or pilot entry, zero fuel weight...) the FMS can display performance predictions at WPT's.

(b)In flight (Take off, Climb, Cruise, Descent, Approach phases)

As the flight progresses, navigation and performance data are computed and displayed. The crew has the possibility to manually alter the flight plan on the CDU and the change will be displayed both on the CDU and EFIS (Navigation display).

The radio stations (VOR/DME) required for position updating are automatically tuned. The FMS will attempt to use GPS (if fitted).

The FMS provides TRP mode management according to flight phases.

Steering commands (lateral and vertical) and thrust target are provided to the AFS.

The system will provide advisory information for the aircraft from take-off to approach and will be coupled to AP from take-off to approach.

The responsibility to disengage the guidance rests entirely on the crew.

(c)At landing (DONE phase)

R **ON A/C 001-100,

- the active flight plan is cleared when landing gear is compressed and both fuel flows are less than 200 kg/h.

R **ON A/C 101-200,

- the active flight plan is cleared when landing gear is compressed and both fuel flows are less than 441 pounds/h.

R **ON A/C ALL

NOTES : - A secondary F-PLN is never automatically cleared at landing.
- If the sec F-PLN is in any part made by a copy from the active F-PLN the portion of the sec F-PLN which is common

to the active F-PLN is cleared when the aircraft has passed over this common part. Otherwise it shall not be cleared.
- Activation of a sec F-PLN does not put the former active F-PLN into the sec F-PLN but keeps the sec F-PLN.

(3)Support functions

(a)IRS

1 Alignment

On the ground it will be possible to align the IRSs. Corresponding latitude and longitude will be provided by the data base and are modifiable by the pilot.

2 Monitor

(Ref. Fig. 001)

- Acess LS key from maintenance page accessible in PREFLIGHT and DONE phase.
- Average drift rate (Kts) of each IRS from "take off" to "landing". Begin condition : airborne and ground speed greater than 60 Kts. End condition : airborne and ground speed lower than 60 Kts.
- Ground speed (Kts) of each IRS is recorded at "Engine stop" and displayed at a resolution of 1 Kt.
- At take-off and landing (points 1 and 2), the IRS and FMS positions and the GMT are recorded.
- Drift rate is given by :

$$\frac{(\text{IRS pos.2} - \text{AFMS pos.2}) - (\text{IRS pos.1} - \text{AFMS pos.1})}{(\text{GMT2} - \text{GMT1})}$$

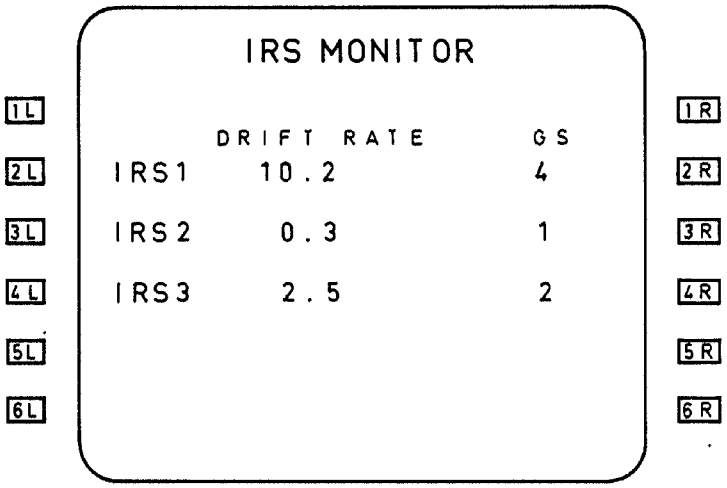
(b)Initial loading/on-ground planning

Prior to flight (preflight), the system initialization function shall solicit information from the flight crew which is required for the intended operation of the system during flight. This shall include basic lateral definition and performance data initialization.
These may consist of selection of :
- company route number or FROM - TO (origin and destination)
- alternate route number
- departure and arrival area procedures (SID, STAR)
- performance mode (ECON by default)
- meteorological information (temperature and wind)
- weight and fuel data (e.g. zero fuel weight and block fuel)

Those selections provide on-ground planning for the whole flight and predictions at each waypoint.
This planning is based on the lateral defined flight plan and provides information about speed, altitude and time (ETE) at waypoints, and fuel and weight information.

(c)In-flight planning situations

An in-flight planning is also possible :
(Ref. Fig. 002)
- on the primary flight plan from P POS to any waypoint and to planned destination and alternate.
- on the secondary flight plan from P POS to any waypoint and any new destination and new alternate taking into account any pilot inserted route modification. It is assumed in this case that the secondary F-PLN contains the active leg of the active F-PLN.



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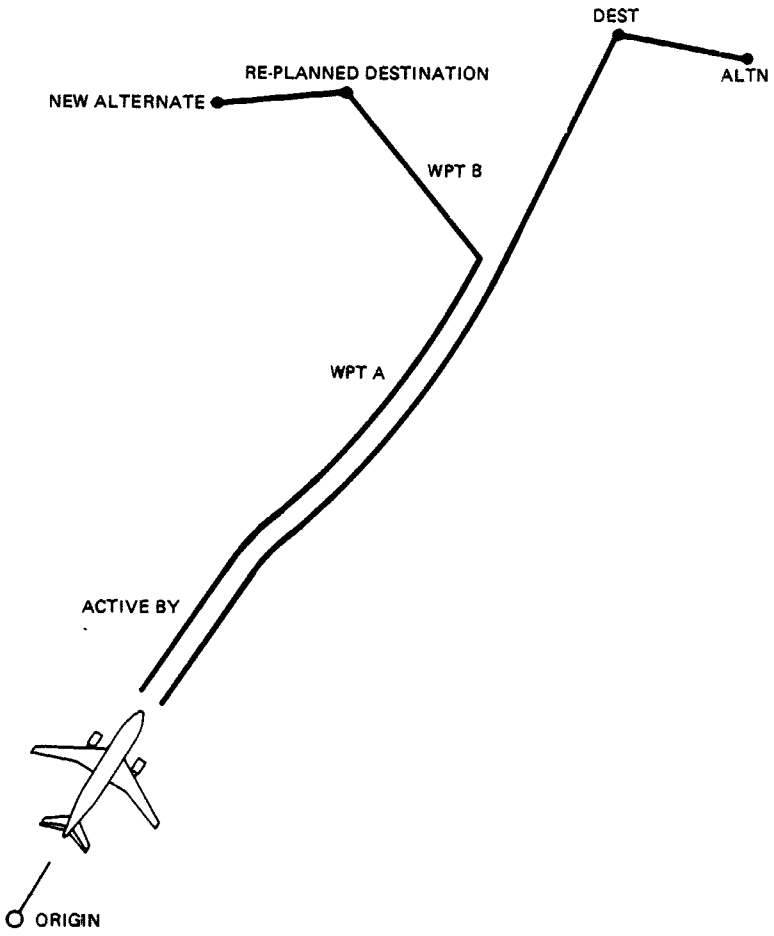
IRS Monitor Page
Figure 001

R



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In-flight Planning
Figure 002

(4)Fuel management
(a)Fuel policy
Through program pins (max of 4), the FMS has the possibility to manage the airline fuel policy.

R **ON A/C 001-100,

TABLE 1
Only basic value is announced for example :

AIRLINE	TAXI/KG	RTE RSV %	RTE RSV UPPER LIM/KG	RTE RSV LOWER LIMIT/KG	FINAL MIN
Basic (default value)	200	5	1200	500	30

R **ON A/C 101-200,

TABLE 1
Only basic value is announced for example :

AIRLINE	TAXI/ POUND	RTE RSV %	RTE RSV UPPER LIM/POUND	RTE RSV LOWER LIMIT/POUND	FINAL MIN
Basic (default value)	441	5	2645	1102	30

R **ON A/C ALL

(b)Fuel predictions and EXTRA computations
1 On the ground
Assuming a ZFW and BLOCK FUEL is entered by the pilot the basis of computation is the following :
BLOCK FUEL - (TAXI + TRIP FUEL + RTE RSV + ALTN + FINAL) = EXTRA
Note : RTE RSV and FINAL can be changed by the pilot on the INIT CDU page.
2 In flight
The basis of computation is the following for fuel prediction at P POS :
FOB - (TRIP FUEL from P POS to DEST + RTE RSV from P POS to DEST + ALTN + FINAL) = EXTRA
Note : RTE RSV and FINAL can be changed by the pilot on the FUEL CDU page.
The basis of computation is the following for fuel prediction at WPTs :
EFOB (estimated fuel on board at WPT) - (TRIP FUEL from WPT to DEST + RTE RSV from WPT to DEST + ALTN + FINAL) = EXTRA
Note : RTE RSV and FINAL can be changed by the pilot on the FUEL CDU

page.
Fuel prediction during holding with manual termination (HM)
The basis of computation is the following :
(TRIP FUEL from P POS to DEST + RTE RSV from P POS to DEST + ALTN + FINAL) = FUEL LIMIT
Notes : (1) RTE RSV can be changed by the pilot on the Hold CDU page. ALTN can be deleted on the Hold CDU page and FUEL LIMIT changes accordingly.
(2) EXTRA is automatically converted into FUEL LIMIT. Other predictions along the remaining part of the flight plan are based on the aircraft leaving the holding at the next fix.

(c)Use of EXTRA data
During flight the decreasing route reserve not used is converted to EXTRA fuel also :
- During normal flight
EXTRA FUEL may be more and more positive toward the destination
- For reclearance
The EXTRA has to be monitored by the pilot since it is not monitored by the FMC to indicate the point of reclearance. Also if the EXTRA FUEL is :
negative at the beginning of the flight. It has to become positive during the flight.
The point where the EXTRA FUEL becomes zero is the predicted earliest point from which a continuation to the destination is legal.
OPERATIONAL RULE FOR THE RECLEARANCE POINT
THE EXTRA FUEL OVER THE RECLEARANCE POINT MUST ALWAYS BE POSITIVE

R **ON A/C 001-100,

(5)Clearing data at end of flight
When the flight phase transitions to DONE on ground and both fuel flows ≤ 200 Kg/h, certain data within the FMC are cleared or reset to default values.
Some variables within the FMC that use default values will be reset to the default value. These are :

R **ON A/C 101-200,

(5)Clearing data at end of flight
When the flight phase transitions to DONE on ground and both fuel flows ≤ 441 pounds/h certain data within the FMC are cleared or reset to default values.
Some variables within the FMC that use default values will be reset to the default value. These are :

R **ON A/C ALL

TROPO FINAL FUEL/TIME
SPD LIM ECON <--- ACTIVE MODE

DEST QNH	ZFWCG
TAXI FUEL	DAY/MONTH
RTE RSV	FF + FQ (sensors used)

Other variables entered by the pilot or FMC calculated are cleared to allow reinsertion of new values. They include :

EXTRA FUEL/TIME	VR
ZFW	BLOCK FUEL
GW	FLIGHT PLAN FROM/TO
FOB	COST INDEX (cleared but remembered for default value if necessary, see INIT page A)
LW	LAT/LONG on INIT page A
V1	DES FORECAST ENTRIES
T.O SHIFT	DESELECTED NAVAID
AIDS DATA	FLT NO.
	CO RTE NO.
	CRZ FL
	BRG/DIST to WPT on PROG page
	FMS - created waypoints
	REMOTELY TUNED NAVAID

There is a third set of variables that defaults to entry prompts when the flight phase transitions to **DONE** and then defaults to a value at another time.
The variables and when they default are listed below :
CRZ TEMP - defaults when the **CRZ FL** is entered
CRZ WIND
If the **F-PLN** is prepared by **INIT** page **A** the default values are standard value for temperature **(ISA)** and zero for wind (direction and velocity).
If a secondary **F-PLN** was already prepared by the pilot and if the pilot activates it on ground (e.g. for training) the default values will be the result of average temperature and wind memorized from the previous flight.
THR RED ALT - default as specified in **VERT REV** logic
ACCEL ATL
EO THR RED ALT
EO ACCEL ALT

B. CDU Description

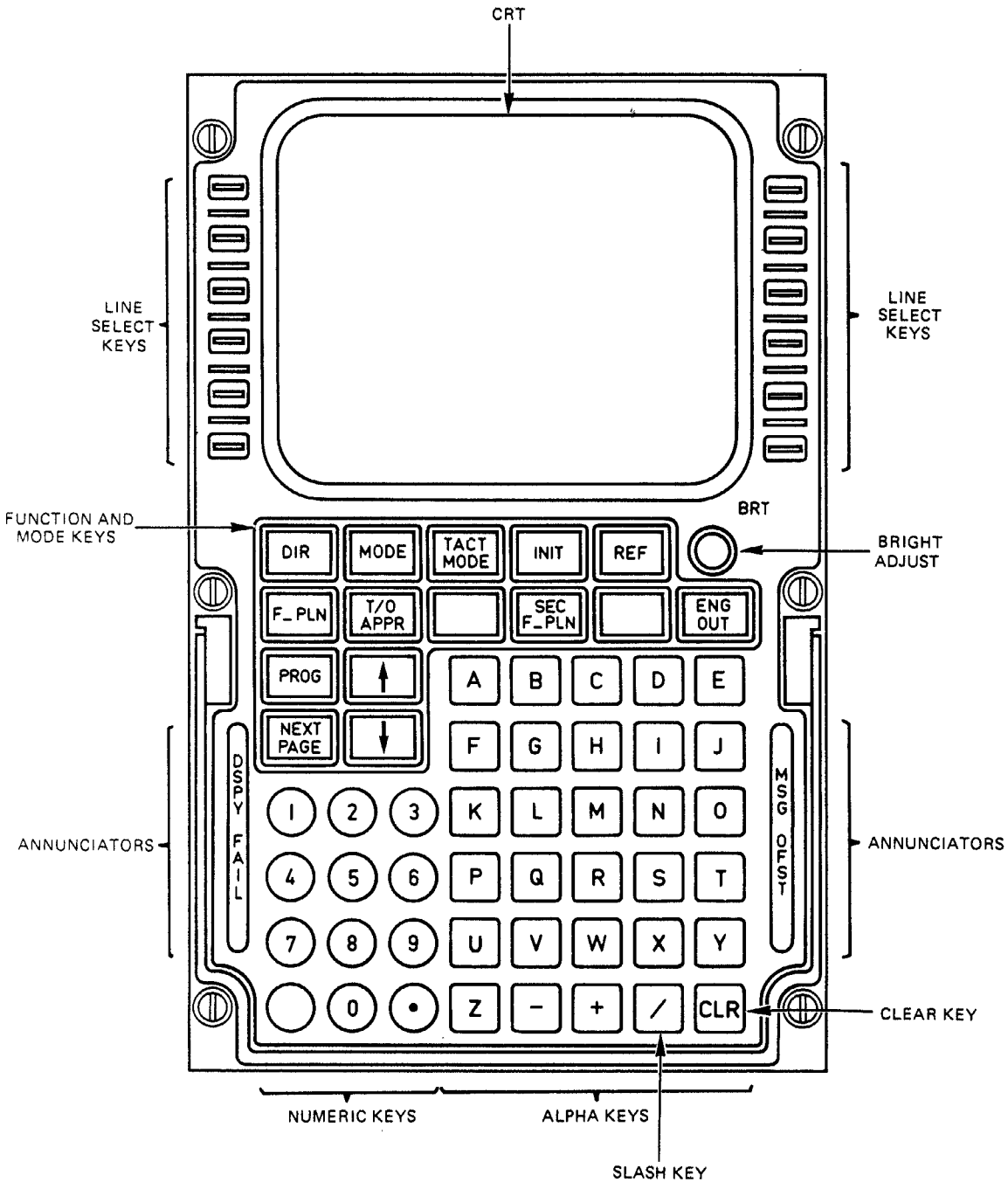
(1)Introduction

(Ref. Fig. 003)

The interface between the crew and the FMC is the CDU. Inputs from the pilot are done through keys ; outputs from the system are provided through the CRT and annunciator lights.

Operationally speaking, the CDU is divided into 8 different areas :

- CRT
- Scratchpad line on CRT
- Line select keys (LS keys)
- Function and modes keys
- Annunciators
- Numeric keys
- Alpha keys
- Clear key



BM5 34 63 00 0 ALM0 11-06
DM5

Control Display Unit (CDU)
Figure 003

(2)Concept of paging on the CRT

CDU displays consist of pages that are displayed on the CRT. Each mode key (except ENG OUT) has certain pages associated with it and each page has certain data available to it.

- The name of each page is displayed and beneath the name is listed the type of information displayed on that page.
- Some mode keys display different pages depending upon when they are pressed during the flight. (i.e. TACT MODE, TO/APPR)
- Page accessing is done automatically or by a LS key or mode key. If a page appears to have no exit route, a mode key must be pressed to change pages.

(3)General display rules

(a)CDU display layout

The CDU display contains 14 lines, each having 24 characters. The top line (line 1) is normally used as a title line or to display data to which the pilot does not have access. The bottom line (line 14) is the scratchpad line and is used by the pilot to alter the data in the data fields. Columns 23 and 24 of the scratchpad line are reserved for vertical slew indicators.

Lines 2 through 13 are data lines arranged into six pairs (lines 2-3, 4-5, 6-7, 8-9, 10-11, 12-13). Each pair of lines has a label line (the top of the two lines) and a data line adjacent to the line select keys. The line pairs are referenced by line select keys as follows.

Reference	CRT Lines
1L - 1R	2 - 3
2L - 2R	4 - 5
3L - 3R	6 - 7
4L - 4R	8 - 9
5L - 5R	10 - 11
6L - 6R	12 - 13

NOTE : All angular information in the data base is referenced to magnetic north (except ILS center beam bearing). The FMS converts these angles to true reference for use by other FMC functions (guidance, EFIS...). However, for CDU display purpose all course and heading are in magnetic degrees (except wind and raw GPS true track on the GPS MONITOR page (optional)).

(b)Non-valid and missing data

For all display fields only valid data will be displayed. If the data are not valid for display or not available for display, the display field will contain dashes (----). An example of this is is performance is calculating optimum altitude, the OPT FL field would be dashes until the calculation is complete.

When a new page is accessed it may require that the FMCS performs calculations or predictions before all the data to be displayed are available. In this case, the portion of the display that is available and can be displayed is presented to the pilot quickly. However, the data fields that are not available would be left as dashes and filled in as the data become available.

(c)Small or large font

On the CDU there are two sizes of fonts. Generally, all data on the

data line (line adjacent to LS key) are displayed in large font and data on the label line are displayed in small font. However, the following are exceptions :

1 Data with default values or FMS predicted values which could be changed by the pilot are displayed in small font when the FMS supplied data are being used and large font when the data are pilot entered. An example of this would be predictions on the flight plan page that are in small font versus constraints on the flight plan page that are in large font.

2 If two data entries are dependent upon each other (such as time and distance for holding pattern leg) the independent data (those defaulted to or latest input by the pilot) are displayed in large font and the dependent data are in small font.

3 If there are active or selected data displayed with nonactive or nonselected data, the active or selected data will be displayed in large font while the other are in small font. See MODE page for a demonstration of this rule.

(d)Special symbols or displays

There are special symbols on CDU displays that indicate certain functions to the pilot. Certain symbols may give a clue to the pilot as to what is available or if there is more information than is already displayed.

The following symbols are used in the displays :

< or > If this symbol appears next to a LS key it indicates that pressing that LS key will only cause the CDU to display a different page.

* This symbol appearing beside a LS key indicates that pressing the key causes a change to parameters which affect the active situation of the aircraft.
The page displayed may also change as a result.

[ ] This indicates that the flight crew may enter this data (can be optional).

|_| This indicates that the data are necessary for the pilot to input in order for the FMC to perform the specific function.

--- This indicates that the data will be calculated and displayed by the FMCS when it has enough information to do so. The flight crew does not normally enter this information. However, under certain circumstances they may be able to alter the data.

These arrows (up or down) indicate that vertical slewing is available. They will appear in columns 23 and 24 in the scratchpad.

---> This arrow, in column 23 of the title line indicates that horizontal slewing is available from this page. Pressing the NEXT PAGE key will horizontally slew the page.

+, - Whenever an altitude at a waypoint is constrained it is displayed in large characters. A plus (+) is displayed for an **AT** or **ABOVE** altitude constraint and a minus (-) for an **AT** or **BELOW** altitude constraint.

Δ This symbol beside a fixed waypoint on the flight plan page indicates that the aircraft must overfly the fixed waypoint.

(e) Entering altitude or flight levels

Altitude-related fields can be entered as either an altitude or flight level. If two or three digits are entered, flight level is assumed and if four or five digits are entered, altitude is assumed. However, if four or five digits are entered and the first two characters are FL (as in FL90), this should be interpreted as a flight level. This means that if 500 feet is entered, it must be entered as 0500. Throughout this specification all altitude entries are with respect to sea level except as noted otherwise.

(f) Waypoint abbreviations

There are certain flight crew entered waypoints in the flight plan (not pertaining to the data base) that are automatically abbreviated. They are **LAT/LONG, PLACE/BRG/DIST** and runway entries.

1 **LAT/LONG** - A **LAT/LONG** that is input by the flight crew as waypoint will be abbreviated on the flight plan page as **LLNN**. **NN** is a two-digit number indicating the number of the **LAT/LONG** definition for each defined waypoint. **LLNN** becomes the identifier of the waypoint and may be used as any other waypoint identifier. A such defined waypoint becomes one of the twenty pilot-defined waypoints. **NN** is therefore a number from 01 to 20 which defines the position of the waypoint in that list.

2 **PLACE/BRG/DIST** - If the flight crew defines a waypoint as a **PLACE/BRG/DIST** the **FMC** will abbreviate this to **PBDNN** where **NN** is a two digit number indicating the number of the **PLACE/BRG/DIST** definition. **PBD** becomes the identifier of the waypoint and may be used as any other waypoint identifier. A such defined waypoint becomes one of the twenty pilot-defined waypoints. **NN** is therefore a number 01 to 20 which defines the position of the waypoint in that list.

3 A runway that is stored in the navigation data base is accessed by entering **ARPT NNA** where **ARPT** is the **ICAO** airport identifier, **NN** is two digits 00-36, and **A** is either a blank or L, R or C if there is more than one runway with the same **NN**. When the waypoint is displayed, the **ARPT** ident. is replaced by the characters **RW**, i.e. the displayed ident is **RWNNA**. This is for display purposes only and any subsequent entry of this waypoint must still use the **ARPTNNA** entry format.
The **FMS** also assigns abbreviations to waypoints at certain times, when legs must be changed or inserted. This occurs due to lateral revisions, or when a leg that must be converted to a different leg type within the **FMC** appears in the data base.

4 **FC** or **FD** leg is changed to a **CF** or **TF** leg. The abbreviation is **AAANN** where **AAA** represents the first three characters of the waypoint from which the course or track is defined and **NN** are the two least significant whole digits of the distance from **AAA** to the leg termination.

5 **CI** or **IT** leg is changed to a **CF** or **TF** leg respectively. The abbre-

viation is **AAANN**, where **AAA** represents the first three characters of the **DME** to which the course or track is defined and **NN** are the two least significant whole digits of the distance from **AAA** to the **DME** arc.

6 **VI** leg is changed to a **VR** leg. The abbreviation is **AAARRR** where **AAA** represents the first three characters of the waypoint from which the radial is referenced and **RRR** is the radial.

7 **VI** leg is changed to a **VD** leg. The abbreviation is **AAANN** where **AAA** represents the first three characters of the **DME** from which the distance is referenced and **NN** are the two least significant whole digits of the distance from **AAA** to the termination.

8 **IF** leg is inserted before a **CF** leg. The abbreviation is **AAANN**, where **AAA** represents the first three characters of the waypoint to which the course is defined and **NN** are the two least significant whole digits of the distance from the leg termination to **AAA**.

If a fixed waypoint is created by the **FMCS** using rules 1, 2 and 5 above (**FMS - CREATED WAYPOINT**), then it becomes part of the data base.

The **FMS** can define a maximum of 16 waypoints. If the **FMS** attempts to define more than 16 waypoints, the capacity logic will apply. If a **FMS** created waypoint is no longer required to define a flight plan, the **FMS** will delete it from the data base

9 **W**ind Entries

Values of **W**ind **D**irection and magnitude (**WIND DIR/WIND MAG**) may be displayed or entered by the pilot on the **INIT A, F-PLN B, VERT REV-B, STEP PRED, FUEL PRED, DES FORECAST** and their corresponding secondary pages.

(4)General keyboard usage
(a)Keyboard and line select keys
(Ref. Fig. 004)

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 005)

**ON A/C ALL

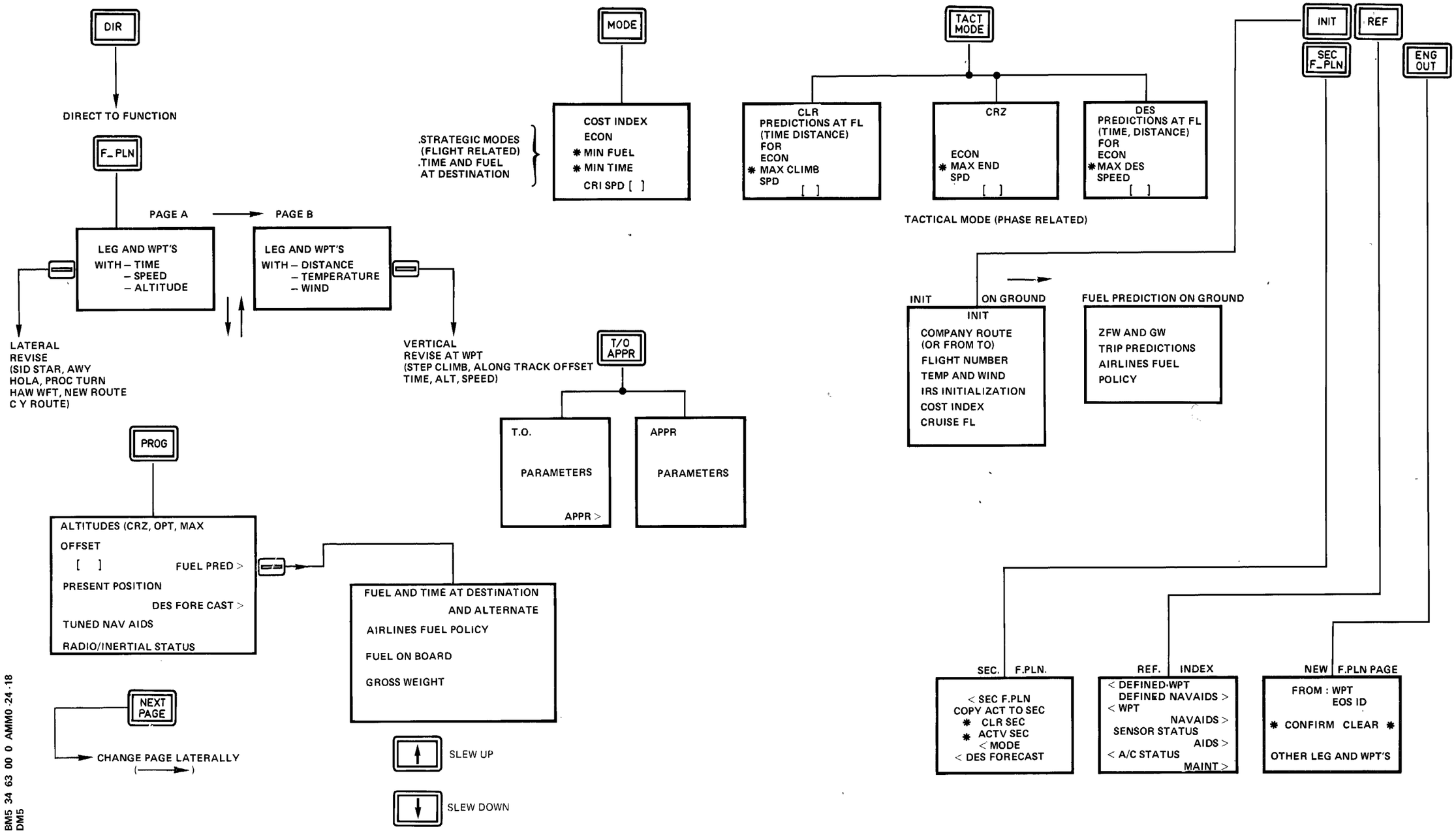
The following is a description of the various types of keys on the keyboard and their general usages.
The following figure contains page accessing diagrams for each of the mode keys. These diagrams are general diagrams that show the sequencing and the type of data in each page.

1 ALPHANUMERIC KEYS :
Pressing an alphanumeric key (0 through 9, A through Z, ., +, -, and /) enters that character into the scratchpad of the CDU.

2 MODE KEYS :
Pressing a mode key causes a new CDU page to be displayed and allows access to a certain function.
The available mode keys are :
- F-PLN
- MODE
- DIR
- PROG
- SEC F-PLN
- INIT
- TO/APPR
- ENG OUT
- REF
- TACT MODE

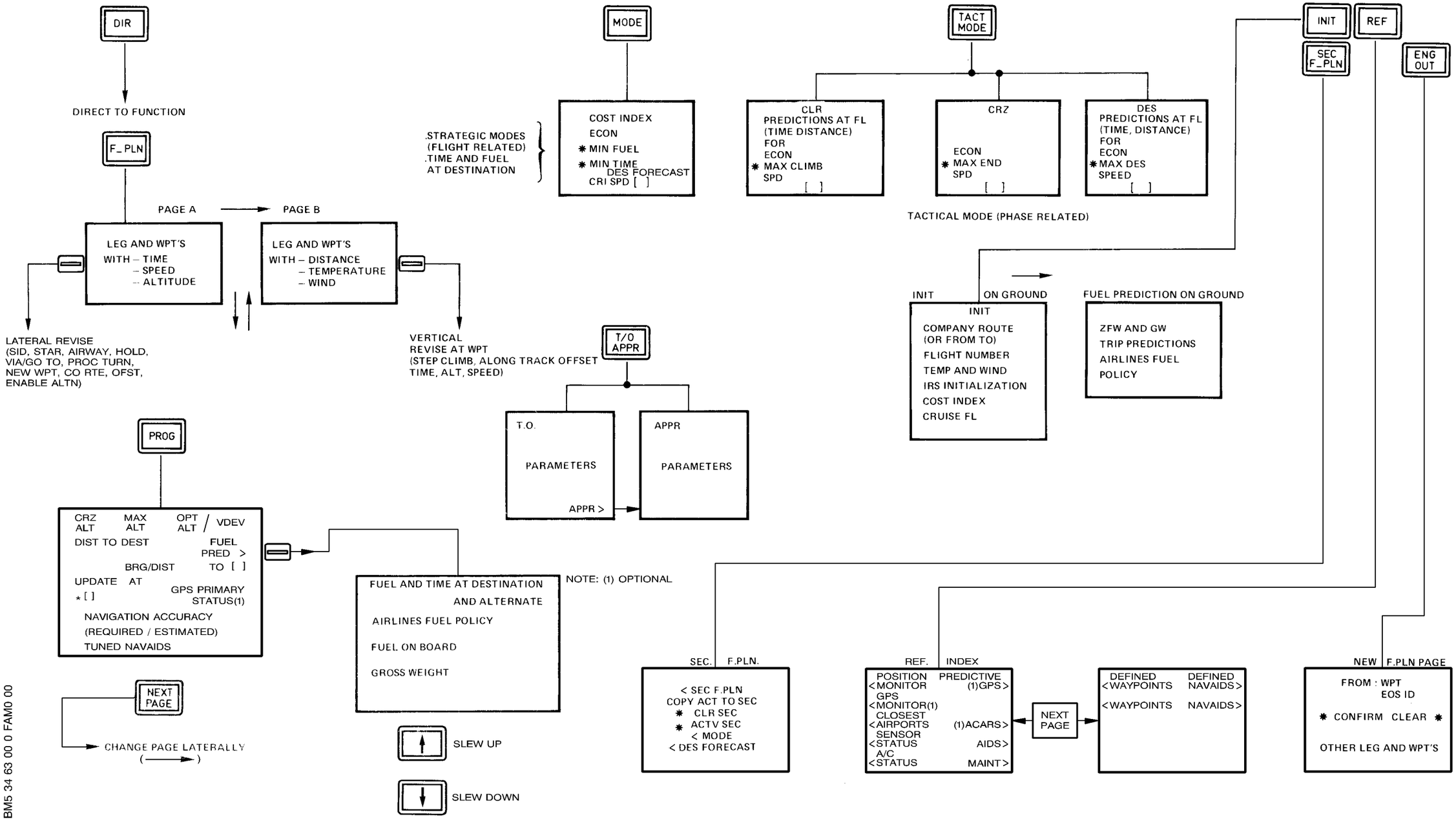
3 Function keys :
- NEXT PAGE - causes horizontal slewing to occur.
- (Slew Up) - causes upward vertical slewing to occur.
- (Slew Down) - causes downward vertical slewing to occur.
- CLR - allows clearing of scratchpad and data fields.
- Line Select keys - allows entry of data into a field and access to data or function identified by that field.

INTENTIONALLY BLANK



BM5 34 63 00 0 AMM0 24.18
DM5

Functions and Mode Key
Figure 004



BM5 34 63 00 0 FAM0 00

Functions and Mode Key
Figure 005

(b)Scratchpad and data field entry

Data are entered into the FMS through the CDU keyboard. First the data are entered from left to right into the scratchpad by pressing the alphanumeric keys on the keyboard. Only 22 characters may be entered into the scratchpad. If more than 22 are entered, they will be ignored and only the first 22 will be used. The 23rd key press will not be accepted by the FMC and the FMC will give no response.

After entry of the data into the scratchpad, the data are moved from the scratchpad into the correct data field by pressing the adjacent LS key. The FMCS checks the data for format and acceptability (out of range, entry not allowed into the field, etc). If the data are incorrect, the system will leave the previous data in the data field and display the associated message indicating the error in the scratchpad. To enter the correct data, the pilot must either ;

1 Clear the message from the scratchpad by pressing the CLR key. The data that was incorrect will appear in the scratchpad. The pilot can then correct the data or clear it.

2 Reenter data into the scratchpad. This automatically clears the message being displayed and replaces the previous (incorrect) scratchpad data.

If the entry is rejected because an incorrect LS key was pressed, then the entry will be accepted once the correct LS key is pressed without performing (1) or (2) above.

To clear the scratchpad of entered data or incorrect data, the CLR key can be used. One press of the CLR key erases the last character entered in the scratchpad. If the CLR key is held down for 2 seconds the entire scratchpad will be cleared of any data.

Certain Data entries (eg. 1L on DIR TO page) also cause the displayed page to be changed automatically. In these cases, any scratchpad data is deleted. Otherwise, it is retained. During a page change, scratchpad entries are ignored.

(c)Clearing data fields

Data fields on the CDU can be cleared using the CLR key. Pressing the CLR key when the scratchpad is empty results in CLR being displayed in the scratchpad. Then, pressing the LS key adjacent to the data field results in clearing that data.

Not all data fields may be cleared. When clearing of a data field is allowed, it is denoted by a C next to the LS key.

The following things may happen when a data field is cleared :

1 If the data have a default or FMC-calculated value, the data revert to this value. If the default value is cleared, the clearing has no effect and there is no message display.

2 If the datum is one of those cleared at landing and then subsequently entered, the data cannot be cleared by the pilot, but the pilot may change the value via scratchpad entry.

3 If the data field is a leg in the flight plan (on F-PLN or SEC F-PLN pages), that leg is deleted from the flight plan.

Once a data field has been cleared, the CLR in the scratchpad is removed. Also pressing any alphanumeric key erases the CLR in the scratchpad and enters the alphanumeric. The FMC must distinguish between the CLR key and C-L-R being entered into the scratchpad via

alphanumeric keys. C-L-R does not enable the clearing function.

(d)Horizontal slewing (NEXT PAGE key)

Multiple pages exist for certain display functions in the FMS. The page A is displayed upon pressing the mode key. The other page (page B) is accessed by using the horizontal slewing function (NEXT PAGE key). The displays that use horizontal slewing are closed loop displays. This means that when the page B is displayed and the NEXT PAGE key is pressed, the display changes to the page A.
The following mode keys have horizontal slewing (an arrow will be displayed in column 23 of the title line when horizontal slewing is available) :
- INIT
- F-PLN
- SEC F-PLN
- RTE SELECTION Page, SENSOR STATUS Page.

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- REF INDEX

**ON A/C ALL

(e)Vertical slewing

Certain pages in the FMS contain more data than will fit on a single page (a page longer than the six pairs of lines available on the display). In these instances vertical slewing can be used to scroll the display up or down a pair of lines to display the remaining information. Each press of a vertical slew key scrolls the CDU display by one line pair. A line pair is a line adjacent to a LS key and its label line. Holding the vertical slew key down scrolls the CDU display at a rate of 1 line pair per second. The arrows will be displayed in column 23 and/or 24 of the scratchpad when vertical slewing is available. The pages that may contain more data than fit on a single page are :
- F-PLN Pages A and B
- SEC F-PLN Pages A and B
- SID page
- STAR page
- AIRWAYS page

- WAYPOINTS on AIRWAY
- DIR TO page
- RTE SELECTION page
- DUPLICATE NAMES page

Certain CDU displays are closed loop for vertical slewing, and others are open loop. Closed loop means that the display information wraps around. When the first line pair is in line 1L-1R and the down slew key is pressed, the last line pair appears in 1L-1R. Also, if the last line pair is in 6L-6R and the up slew key is pressed, the first line pair would scroll into line 6L-6R. Open loop means that if the first line pair is in 1L-1R, the down slew function is not available. Also, if the last line pair is in line 6L-6R the up slew is not available. The following table shows which displays are open or closed loop.

Open Loop	Closed Loop
SID	F-PLN A and B
STAR	SEC F-PLN A and B
RTE SELECTION	DIR TO
AIRWAYS	
WAYPOINTS ON AIRWAY	
DUPLICATE NAMES	

Another use for the vertical slew keys is incrementing data by a set amount in a particular data field. This is available on INIT Page A. When this is available, arrows will be displayed adjacent to the data label that would be affected if the vertical slew keys were pressed. When a vertical slew key is held down, the slewing will take place at a rate of 2 increment per second.

(f)Slash key

The slash key is used to separate data for entry and display. The entries that use the slash key are constraints, environmental data, speed limit, etc.

The entry of leading slashes is necessary and trailing slashes is optional.

(g)Front panel annunciators

There are four annunciators lights on the CDU face :

1 OFST (white) - When a parallel offset is active , this annunciator is on.

2 MSG (white) - This annunciator in on when a message is being displayed in the scratchpad or one is waiting in the message queue.

3 FAIL (amber) - This annunciator is on when the CDU has failed.

4 DSPY (White) - When on it means that the page displayed on the CDU does not coincide with the active situation in the FMC. This is to avoid confusion by the pilot about the active flight situation.

DSPY annunciator is on when in the following situations :

- the F-PLAN page A or B is displayed and the FROM waypoint is not in line 1L - 1R.
- the SEC F-PLAN page A or B is displayed
- the SEC FUEL PREDICATION page is displayed
- the SEC DES FORECAST page is displayed
- the LAT REV or VERT REV pages are accessed from the SEC F-PLAN.
- the RTE SELECTION page is accessed from the SEC INDEX page
- the SEC INDEX page is displayed.

(5)CDU data entry

(a)Overview

The individual display pages for each key will be described later on in detail, line by line in the same order as the keyboard. The rules for entering data into the data fields and the results of pressing the LS keys are given for all six line pairs on the CDU. If a LS key has no information adjacent to it, pressing the LS key is assumed to be no operation and message "NOT ALLOWED" is displayed. This is a general rule for all displays. This rule is also true for fields that are for display only and do not have any function associated with pressing the LS key.

Many of the example pages are taken from situations pertaining to a hypothetical flight from Geneva to Athens. However, a few of the displays contain other fictitious data for explanation purposes. Many of these examples include a three-character waypoint or navaid such as ABC or XYZ, and the data pertaining to the examples (such as LAT/LONG, etc) are not taken from actual situations.

Pressing the LS keys adjacent to the sample displays in the following paragraphs can have the following results :

- Page change - Causes the display to change page.
- Function - Causes a function to happen. Examples of this would be inserting or deleting from the flight plan, etc.
- Entry - Data entry is allowed into this field. If data is already in this field, new data may be entered to replace the present data.
- Dependent - The result is dependent upon other data or circumstances. The dependency is explained for each data field.
- Clear - This field may be cleared using the CLR key.
- Select - These data may be selected. An example of this is selecting a SID or STAR but it is not inserted into the flight plan until its insert LS key is pressed.

(b)Data entry formats and range

TABLE 2
DATA ENTRY FORMATS AND RANGE

Data Name	Format	Range (X is input)	Units	Display Page
ACCEL ALT	See ALT	Specified range	ft (MSL)	TAKEOFF
AIDS DATA	CCCCCC where C is an octal character (0-7). Message "FORMAT ERROR" is displayed if other than 6 valid octal characters are entered.	N/A	N/A	AIDS
ALT	NNNN or NNNNN (leading zeros must be included)	Within range specified for ALT Entry is rounded to the nearest 10 ft.	ft (MSL)	GPS MONITOR (optional) F-PLAN A and B VERT REV A SEC F-PLN A ALONG TRK OFST
ALTN RTE	Same as CO RTE	Same as CO RTE	N/A	INIT A
ALT/WIND DIR/ WIND MAG	ALT or Flight Level/NNN/NNN An entry of 360 is displayed as 0. NNN - leading zero not necessary	See ALT Wind Dir : 0-360 Wind MAG : 0-200	ft (MSL) degrees/ kt	DES FORECAST
ARPT	AAAAA	(if AAAAA is not in the data base airport file, message "NOT IN DATA BASE" will be displayed)		INIT A LAT REV FUEL PREDIC F-PLN A and B SEC F-PLN A and B WAYPOINT DIR TO PREDICTIVE

Data Name	Format	Range (X is input)	Units	Display Page
				GPS (optional)
**ON A/C 001-100,				
BLOCK fuel	NN.N leading zeros may be omitted.	Specified range	thous-ands of kg	INIT B

**ON A/C 101-200,

Data Name	Format	Range (X is input)	Units	Display Page
BLOCK fuel	NN.N leading zeros may be omitted.	Specified range	Thous- and of pounds	INIT B

**ON A/C ALL

Data Name	Format	Range (X is input)	Units	Display Page
ZFWCG	NN.N	10.0 - 40.0	% MAC	INITB FUEL PREDIC
CLASS (navaid)	AAAAAA (refer to range for exact inputs allowed)	VOR DME VORDME VORTAC LOC NDB ILSDME	N/A	NEW NAVAID
CO RTE	XXXXXXX	If not in the NAV data base, message "NOT IN DATA BASE" will be displayed	N/A	LAT REV
CO RTE/FLT	See CO RTE and FLT. May be entered as : CO RTE /FLT CO RTE/FLT CO RTE may be entered alone as XXXXXXX. FLT may be entered alone as /XXXX or both may be entered as XXXXXXX/XXXX	If CO RTE is not in the NAV data base, message "NOT IN DATA BASE" will be displayed	N/A	INIT A MODE SEC MODE

**ON A/C 001-100,

COST INDEX	NNN may be entered as 1-3 digits ; leading zeros may be omitted	0-999	KG/MN	INIT A

**ON A/C 101-200,

COST INDEX	NNN may be entered as 1-3 digits ;	0-999	POUNDS/ HOUR	INIT A

Data Name	Format	Range (X is input)	Units	Display Page
	leading zeros may be omitted			

**ON A/C ALL

CRZ FL	Must be entered as FLIGHT LEVEL	Maximum altitude	ft (MSL)	INIT A and B SEC INDEX PROG

Data Name	Format	Range (X is input)	Units	Display Page
CRZ TEMP	See TEMP	Within OPERATING LIMITS	See TEMP	INIT A FUEL PREDICTION
CRZ WIND	See WIND DIR/MAG	See WIND DIR/MAG	See WIND DIR/MAG	INIT A FUEL PREDICTION
DAY/MONTH	DD/MM where DD is day of month and MM is month of year Leading zeros may be omitted but will be displayed.	DD : 1-31 MM : 1-12	N/A	AIDS
DIST	NN.N (leading and trailing zeros may be omitted)	0-99.9 in .1 NM increments	NM	HOLD ALONG TRK OFST
DRAG FACTOR	N.N (leading or trailing zero may be omitted)	-9.9-5.0	N/A	A/C STATUS
ELV	±NNNN if + or - is not input, assume + ; leading zeros may be omitted	-1000 - +20470	ft (MSL)	NEW NAVAID NEW WAYPOINT
EO ACCEL ALT	Same as ALT	Specified range	ft (MSL)	TAKEOFF
EO THR RED ALT	Same as ALT	Specified range	ft (MSL)	TAKEOFF

**ON A/C 001-100,

Data Name	Format	Range (X is input)	Units	Display Page
EXTRA/TIME	FUEL (see BLOCK)/TIME (see GMT) Only one may be entered at a time. To input fuel - enter FUEL (see BLOCK) ; to input time - enter /TIME	See BLOCK and GMT	thous-ands of kg/hours minutes	INIT B FUEL PREDIC-TION

**ON A/C 101-200,

Data Name	Format	Range (X is input)	Units	Display Page
EXTRA/TIME	FUEL (see BLOCK)/TIME (see GMT) Only one may be entered at a time. To input fuel - enter FUEL (see BLOCK) ; to input time - enter /TIME	See BLOCK and GMT	Thous-ands of pounds/ hours minutes	INIT B FUEL PREDIC-TION

**ON A/C ALL

FF+FQ Sensors	One or both may be entered. Both -/FF+FQ or /FQ+FF Fuel Flow -/FF Fuel Quantity -/FQ		N/A	FUEL PREDIC-TION
FF Factor	Same as DRAG FACTOR	Same as DRAG FACTOR	N/A	A/C STATUS

Data Name	Format	Range (X is input)	Units	Display Page
FIG OF MERIT	N	0-3	N/A	NEW NAVAID
FLIGHT LEVEL	FLNNN or NNN Leading zeros on NNN may be omitted	NNN	hundreds of ft (MSL)	F-PLN A and B PROG VERT REV A INIT A and B SEC INDEX SEC F-PLN A SEC F-PLN B ALONG TRK OFST TACT MODE STEP PRED
FLP RTR	Same as SPD	Same as SPD	kt(CAS)	TAKEOFF APPR

**ON A/C 001-100,

FOB	Same as BLOCK	Same as BLOCK	thous-ands of kg	FUEL PREDIC-TION

**ON A/C 101-200,

FOB	Same as BLOCK	Same as BLOCK	Thous-ands of pounds	FUEL PREDIC-TION

**ON A/C ALL

FREQ	NNN.NN	108-117.95	MHz	NEW NAVAID

Data Name	Format	Range (X is input)	Units	Display Page
FROM/TO	AAAAA/AAAAA	AAAAA must be in data base or message "NOT IN DATA BASE" will be displayed	N/A	INIT A

**ON A/C 001-100,

FINAL/TIME	Same as EXTRA/ TIME	See BLOCK and GMT	thous- ands of kg/hours minutes	INIT B HOLD FUEL PREDICTION

**ON A/C 101-200,

FINAL/TIME	Same as EXTRA/ TIME	See BLOCK and GMT	Thous- ands, of pounds /hours minutes	INIT B HOLD FUEL PREDICTION

**ON A/C ALL

GMT	HHMM Where HH are hours and MM are minutes. Leading zeros may be omitted. 1 or 2 digit. entry is interpreted as minutes	HH : 0-23 MM : 0-59	hours minutes	VERT REV A
INB CRS	NNN Leading zeros may be omitted An entry of 360 is displayed as 0.	0-359	degrees	PROC T HOLD
INB DIST	Same as DIST	0-99.9, see range on OUTB CRS for PROC T restriction	NM	PROC T

Data Name	Format	Range (X is input)	Units	Display Page
LAT	DDMM.MB or BDDMM.M DD - degrees MM.M - minutes B - direction Leading zeros may be omitted but the direction (B) is necessary. LAT is displayed as DDMM.MB	B : N or S Ø ≤DD≤90 Ø ≤MM.M≤59.9	degree minutes tenths of minutes	INIT A
LAT/LONG	LAT/LONG Same as LAT and LONG except both must be entered with/ in between.	Same as LAT and LONG	Same as LAT and LONG	PROG F-PLN A and B NEW WAYPOINT NEW NAVAID SEC F-PLN A and B DIR TO LAT REV POSITION MONITOR (Optional) GPS MONITOR (Optional)

Data Name	Format	Range (X is input)	Units	Display Page
LONG	DDDMM.MB or BDDDMM.M DDD - degrees MM.M - minutes B - direction Leading zeros may be omitted, but the direction (B) is necessary. LONG is displayed as DDDMM.MB.	B : E or W Ø ≤DDD≤180 Ø ≤MM.M≤59.9	degree minutes tenths of minutes	INIT A
MACH	.NN The decimal point is necessary. Trailing zeros are not necessary	Limited by operational limits	Mach number	F-PLN A SECF-PLN A VERTREV A CLB TCT MODE CRZ TCT MODE DES TCT MODE MODE
MACH/SPD	MACH and SPD must be inserted with/between (see MACH and SPD formats)	Same as MACH and SPD	Same as MACH and SPD	DES TACT MODE
MDA	Same as ALT	Same as ALT but must be less than present A/C ALT	ft (MSL)	APPR
NAVAID	XXXX (must be at least 3 characters)	Any alphanumeric ; if entry not found in the data base NAVAID file message "NOT IN DATA BASE" will be displayed	N/A	PROG NEW NAVAID NAVAID WAYPOINT F-PLN A and B LAT REV SEC F-PLN A and B DIR TO
OFST	NNB or BNN NN - Offset distance	B : L or R 1≤ NN ≤99	NM	LAT REV at the FROM Waypoint

Data Name	Format	Range (X is input)	Units	Display Page
	B - direction Leading zero on distance may be omitted. **OFST** will always be displayed as **BNN.**			

Data Name	Format	Range (X is input)	Units	Display Page
OUTB CRS	Same as INB CRS |alpha ≤90° An entry of 360 is displayed as 0.	0-360 alpha 90 (alpha defined in Fig. ADM0 If the other CRS has not been entered, always allow entry between 0-360	degrees	PROC T
PLACE/BRG/DIST	PLACE can be any data base ARPT, NAVAID or WAYPOINT BRG must be a 3-digit entry. Decimal place may be omitted. An entry of BRG = 360.0 is displayed as 0.0 DIST is NNN.N where leading zeros may be omitted ; all 3 parameters must be entered with / between	PLACE - if not in data base, message "NOT IN DATA BASE" will be displayed BRG - 360.0 DIST - Ø-999.9	BRG - degrees DIST-NM	F-PLN A and B SEC F-PLN A and B LAT REV NEW WAYPOINT PROG DIR TO
QNH	NNNN.N (leading and trailing zeros may be omitted)	950-1050	millibars	DES FORECAST INIT A

**ON A/C 001-100,

RTE RSV	May be entered as fuel or percentage of trip fuel but not both	FUEL - see BLOCK % : Ø-9.9	thousands of kg and %	INIT B HOLD PLAN FUEL PREDICTION

**ON A/C 101-200,

RTE RSV	May be entered as fuel or percentage of trip	FUEL - see BLOCK % : Ø-9.9	Thousands of	INIT B HOLD PLAN FUEL PREDIC-

Data Name	Format	Range (X is input)	Units	Display Page
	fuel but not both		pounds and %	TION

**ON A/C ALL

FUEL	See BLOCK			

Data Name	Format	Range (X is input)	Units	Display Page
RWY	AAAANND where AAAA is same as ARPT NN is runway number (2 digits must be entered) D is L or R if there is more than one runway with the same number at the airport. D is not included unless there is more than one runway with the same number as AAAA.			Same as WAYPOINT
RW CRS	Same as INB CRS	Same as INB CRS	degrees	NEW WAYPOINT

**ON A/C 001-100,

RW LENTGTH	NNNN Leading zeros may be omitted	1000-8000	meter	NEW WAYPOINT

**ON A/C 101-200,

RW LENTGTH	NNNN Leading zeros may be omitted	3281-26245	ft	NEW WAYPOINT

**ON A/C ALL

SLT RETR	Same as SPD	Same as SPD	Kt (CAS)	TAKE OFF APPR
SPD	NNN (must be 3	Limited by operational limit	kt(CAS)	F-PLN A SEC F-PLN A

Data Name	Format	Range (X is input)	Units	Display Page
	numerics)			VERT REV A CLB TACT MODE CRZ TACT MODE DES TACT MODE MODE

Data Name	Format	Range (X is input)	Units	Display Page
SPD LIM	SSS/NNNNN SSS is a speed (see SPD for rules) NNNNN is an ALT or FLIGHT LEVEL (see ALT and FLIGHT LEVEL) SPD and ALT must be entered with/between	SSS same as SPD. NNNNN must be within range specified by operational limits	kt/ft (MSL)	F-PLN A SEC F-PLN A VERT REV A and B
SPD/MACH	See MACH/SPD	Same as MACH and SPD	Same as MACH and SPD	CLB - TACT MODE
STATION DEC	NND Where NN is the declination and D is the direction Leading zeros may be omitted. D is not required for an entry of zero declination.	NN : 0-99 D : E or W	degrees	NEW NAVAID
STEP TO ALTITUDE	Same as ALT or FLIGHT LEVEL	See ALT and FLIGHT LEVEL	See ALT and FLIGHT LEVEL	STEP PRED
STEP TO WIND	Same as WIND DIR/MAG	Same as WIND DIR/MAG	Same as WIND DIR/MAG	STEP PRED

**ON A/C 001-100,

Data Name	Format	Range (X is input)	Units	Display Page
TAXI	N.N Leading or trailing zeros may be omitted	10 OPERATING LIMITS	Thous-ands of kg	INIT B

**ON A/C 101-200,

Data Name	Format	Range (X is input)	Units	Display Page
TAXI	N.N Leading or trailing zeros may be omitted	10 OPERATING LIMITS	Thous-ands of pounds	INIT B

**ON A/C ALL

TEMP	±NN If no sign, assume +	See Para : OPERATING LIMITS	degrees centi-grade	F-PLN B SEC F-PLN B VERT REV B
THR RED ALT	See ALT	Specified range	ft (MSL)	TAKEOFF
TIME	N.N	Ø-9.9	minutes	HOLD (LAT REV)

**ON A/C 001-100,

TOGW and GW	NNN.N Leading and trailing zeros may be omitted	Operating limits	Thous-ands of kg	INIT B (TOGW) FUEL PREDIC-TION (GW)

**ON A/C 101-200,

TOGW and GW	NNN.N Leading and trailing zeros may be omitted	Operating limits	Thous-ands of pounds	INIT B (TOGW) FUEL PREDIC-TION (GW)

**ON A/C 001-100,

Data Name	Format	Range (X is input)	Units	Display Page
T.O SHIFT	NNNN	1. Length of origin running	m	TAKE OFF

**ON A/C 101-200,

T.O SHIFT	NNNN	1. Length of origin running	ft	TAKE OFF

**ON A/C ALL

TROPO	Same as ALT	Same as ALT	ft	INIT A FUEL PREDIC- TION SEC FUEL PREDICTION
WIND	Same as WIND DIR/MAG	Same as WIND DIR/MAG	Same as WIND DIR/MAG	F-PLN B SEC F-PLN B VERT REV B FUEL PREDIC- TION

Data Name	Format	Range (X is input)	Units	Display Page
V/S	NNNN Leading zeros may be omitted	-6000 to +6000 (see Note 1)	ft/minute	F-PLN A F-PLN B
V1	Same as SPD	Limited by operational limits	kt (CAS)	TAKEOFF
VFTO	Same as SPD	Same as SPD	kt (CAS)	TAKEOFF APPR
VR	Same as SPD	Limited by operational limits	kt (CAS)	TAKEOFF
WAYPOINT	XXXXX - may be from 1-5 characters for waypoint. Acceptable as waypoint IDENT: ARPT RWY NAVAID WAYPOINT or F-PLN A and B, SEC F-PLN A and B, LAT REV pages and LAT/LONG, PLACE/BRG/DIST may be entered to define a waypoint	Must be in data base unless LAT/LONG or PLACE/BRG/DIST ; if not in data base, message "NOT IN DATA BASE" will be displayed	N/A	WAYPOINT NEW WAYPOINT F-PLN A and B SEC F-PLN A and B LAT REV PROG DIR TO PREDICTIVE GPS (Optional)
WIND DIR/WIND MAG	NNN/NNN Both must be entered ; leading zeros may be omitted An entry of WIND DIR = 360 is displayed as 0.	WIND DIR : 0-360 WIND MAG : Ø-200	degrees kt	F-PLN B SEC F-PLN B VERT REV B

**ON A/C 001-100,

ZFW	NNN.N leading and trailing zeros	OPERATING- LIMITS	Thousands of kg	INIT B

Data Name	Format	Range (X is input)	Units	Display Page
	may be omitted			

**ON A/C 101-200,

ZFW	NNN.N	OPERATING- LIMITS	Thous-	INIT B
	leading and		ands	
	trailing zeros		of	
	may be omitted		pounds	

**ON A/C ALL

NOTE : Either entry will be interpreted by the FMC as a negative vertical speed.

(6)Messages

(a)Display messages

(Ref. Fig. 006)

1 General

There are various messages displayed on the CDU for pilot information. All messages are displayed in the scratchpad line of the CDU. Para (b) defines the messages which may be displayed, their type, and the paragraph which discusses the display and automatic clearing logic for each message.

2 Type I messages

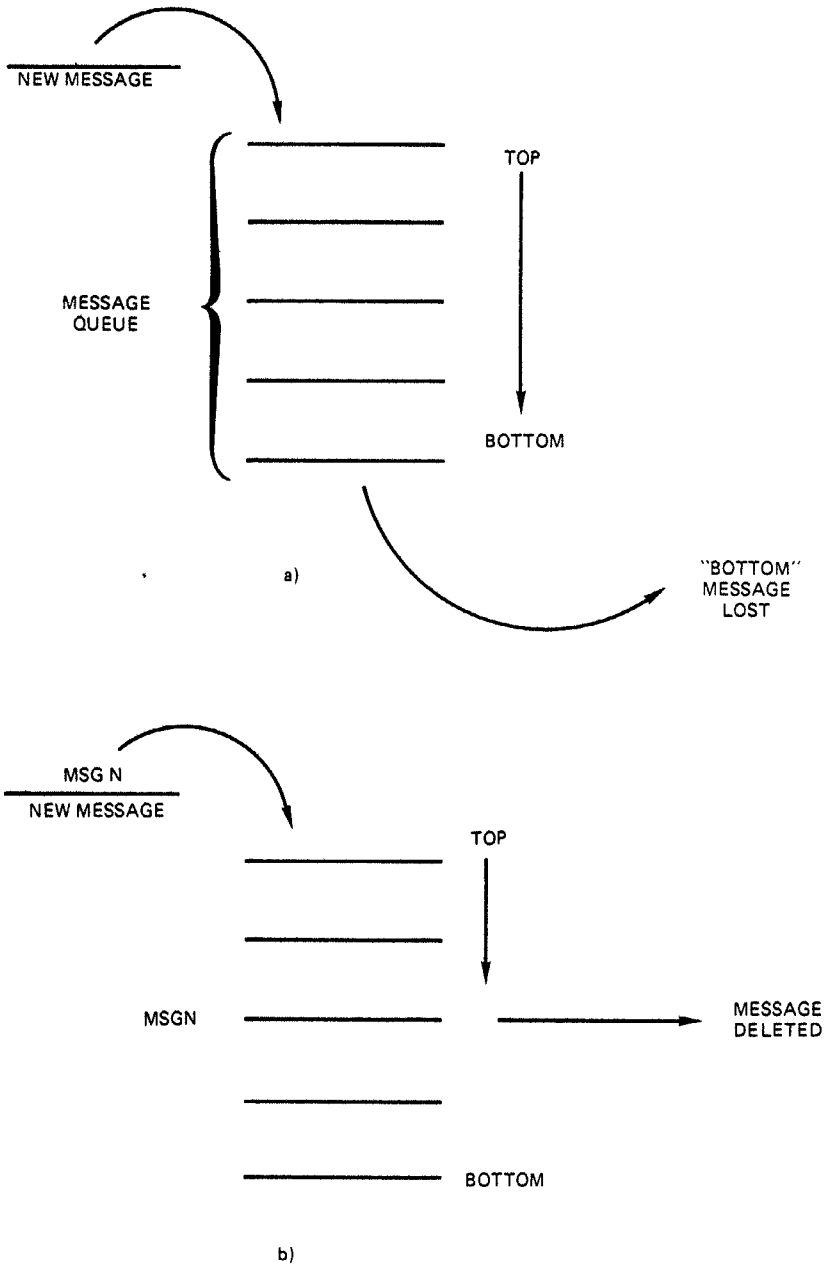
Type I messages are those which are displayed as a direct result of pilot action. There is no message queue for Type I messages. Consequently, a Type I message exists only if it is presently displayed in the scratchpad.

3 Type II messages

Type II messages are those which are displayed automatically to inform the pilot of a given situation or to prompt a pilot action. Type II messages are stored in a last-in/first-out message queue. A maximum of five messages may be stored and if a sixth message is received the one at the bottom of the queue is lost (Ref. Fig. 006). Only one occurrence of a given message can exist in exist in the queue. Therefore, when a message is generated it is placed on the top of the queue and any previous occurrence is deleted (Ref. Fig. 006).

The message which is at the top of the queue is displayed in the scratchpad only if there are no Type I messages or data to be displayed. This results in the following operation :

- A type II message displayed in the scratchpad is suppressed if data is entered. The message is redisplayed when the scratchpad becomes empty.
- A type II message generated while data or a type I message is occupying the scratchpad is displayed only when the scratchpad becomes empty.



BM5 34 63 00 0 ANR0

Message Queue Operation
Figure 006

If a Type II message is cleared while it is occuping the scratchpad, then the next one in the queue is displayed.

As defined when certain Type II messages exist in the message queue the CDU Message discrete is set to "1". If none of the specified messages exists in the queue then the discrete is "0".

(b)Message list

Following is the list of messages that may appear in the scratchpad of the CDU and automatic clearing logic for each message.

- CANCELLING OFFSET II(1)
- DISCONTINUITY AHEAD II(1)
- AAAA ERROR WPT01 ±NNNN II(1)
  AAAA - TIME, SPD, OR ALT
  WPT01 - name of constrained waypoint (maximum five characters)
  ±NNNN - the error at the waypoint in minutes, knots, or feet. Plus (+) is late arrival, too fast, or too high. Minus (-) is early arrival, too slow, or too low.
- TUNE AAA - FFF.FF II(1)
  AAA - the navaid required to compute radio position
  FFF.FF - frequency of navaid
- SPD LIM EXCEEDED II(1)
- MORE DRAG II(1)
- A/C STATUS MISMATCH II
- ENTRY OUT OF RANGE I (2)
- DECELERATE II(1)
- STEP LESS THAN 15 MN I (2)
- FORMAT ERROR I (2)
- ENTER DEST QNH II(1)
- NOT ALLOWED I
- NOT IN DATA BASE I
- INITIALIZE WEIGHTS II(1)
- LIST OF TWENTY IN USE I (2)
- CLOCKS DO NOT MATCH II(1)
- CHECK ALTITUDES II(1)
- TIME CSTR REMOVED II
- F-PLN WPT/NAV RETAINED I
- NEW CRZ ALT - HHHHH I (2)
  HHHHH - newly assigned value for CRZ ALT
- CRZ ALT INVALID II
- USING COST INDEX - NNN I (2)
  NNN - value of cost index
- SEC F-PLN CLEARED I (2)
- ALTN F-PLN CLEARED I (2)
- F-PLN FULL I (2)
- ALIGN IRS II(1)
- INDEPENDENT OPERATION II(1)
- A/C POSITION INVALID I (2)
- WEIGHT LIMIT EXCEEDED II(1)
- VERIFY A/C POSITION II(1)
- IRS ONLY NAVIGATION II(1)
- PLEASE WAIT. II(1)
- SENSOR IS INVALID I (2)
- FMC POSITION MISMATCH II(1)
- CHECK DATA BASE CYCLE II(1)
- DEFAULT STATE ASSUMED II

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- GPS PRIMARY II
- GPS PRIMARY LOST II
- GPS IS DESELECTED II
- NAV ACCUR UPGRAD II
- NAV ACCUR DOWNGRAD II

**ON A/C ALL

NOTE : (1) Type II messages automatically cleared.
(2) Type I messages automatically cleared.

(c)Clearing messages

There are two types of messages and two different ways to clear them.

1 Any message that is displayed can be cleared by pressing the CLR key.

2 Type I messages are automatically cleared as follows :
a. data is entered into the scratchpad
b. a line select or mode key is pressed.

3 As defined in the previous table, certain Type II messages are automatically cleared from the queue when they no longer apply.

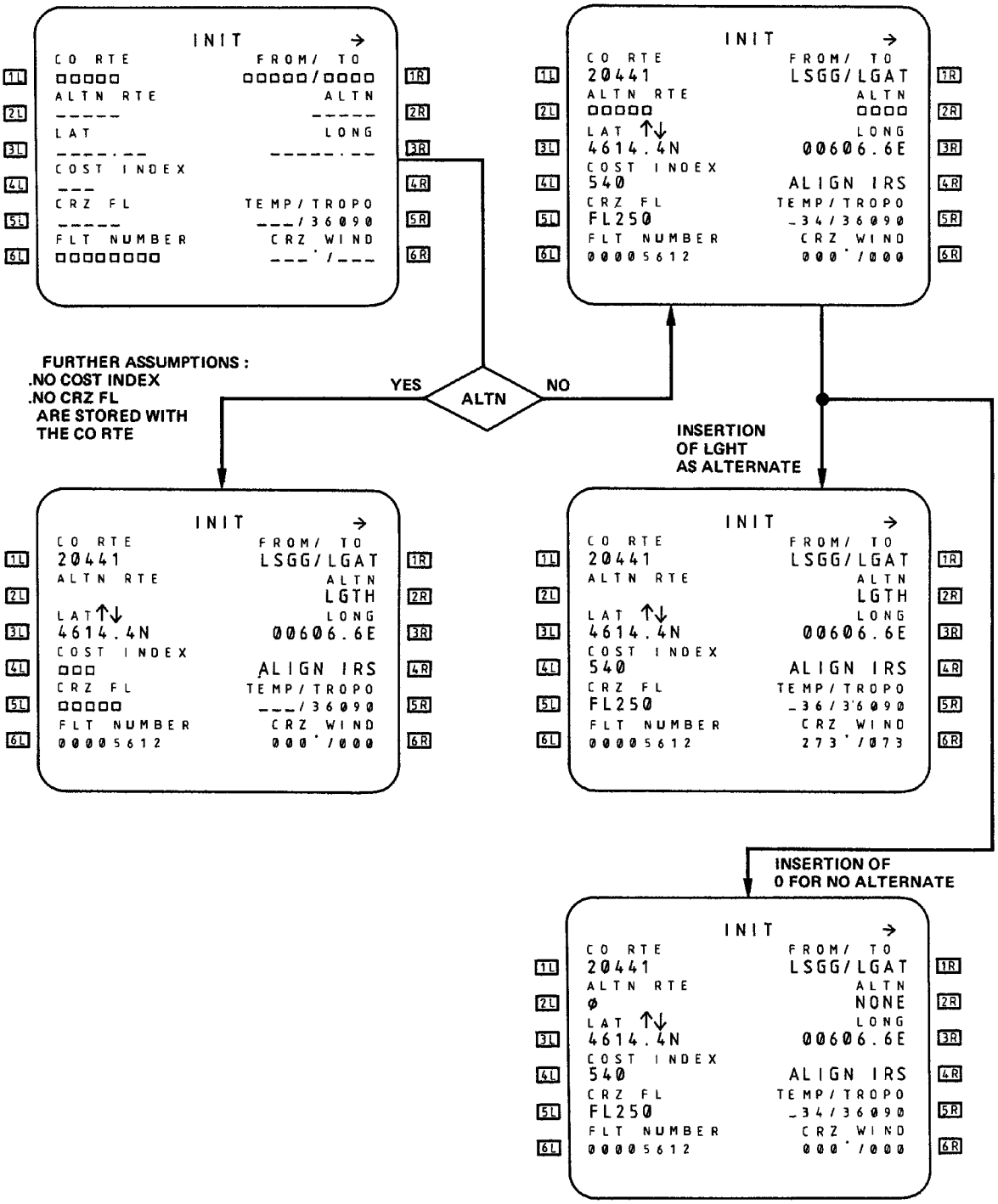
(7)INITIALIZATION KEY (INIT)
(a)INIT page A

**ON A/C ALL

(Ref. Fig. 007)

**ON A/C ALL

- Access - INIT key on CDU face when the aircraft is in the PREFLIGHT or DONE flight phases. If the INIT mode key is pressed when in any other flight phase, message "NOT ALLOWED" is displayed.
  NEXT PAGE from INIT Page B.
  LS key from RTE SELECTION page.
  If the INIT page A is displayed when the flight phase transitions from PREFLIGHT or DONE, to take off, CLB, CRZ, DES or APPR, the display will change to the F-PLN page A.
- Purpose - allows the pilot to define initialization parameters to the system.
- Data Fields
  1L - CO RTE/FLT - The company route may be entered here.
  This CO RTE field can also be filled as a result of a CO RTE selection on the RTE SEL page for the Primary Flight Plan. The CO RTE can be entered without a slash.
  If a FROM/TO is entered in 1R then the CO RTE part of this field becomes blank. A CO RTE may still be entered when the field is blank.
  If any lateral revision, either via the LAT REV Pages or directly on the F-PLN Pages modifies the flight plan defined by the original CO RTE then the CO RTE part of the field is blanked.
  If the flight plan is modified via the ACTIVATE SEC function then the CO RTE number for the secondary flight plan is reflected here.
  1R - FROM/TO - A FROM/TO pair only may be entered into this field. Entry of an airport pair into this field will display the ROUTE SELECTION page and will delete any CO RTE previously entered. This field will be automatically filled upon entry of a company route.
  If an airport pair is displayed in 1R and the LS key is pressed (with the scratchpad empty), the display will change to the ROUTE SELECTION page. Entry of a pilot-defined runway (using the DEFINED WPT function) as the FROM or TO will not access the ROUTE SELECTION Page, but will delete any CO RTE previously entered. Any F-PLN revision (either via the LAT REV page, ACTIVATE SEC on the SEC INDEX page, or directly on the F-PLN page) that defines, changes or deletes the origin or destination will be reflected here. If only a destinations exists, then the FROM field will be blank. If only an origin exists then the TO field will be blank. If neither exists then the



BM5 34 63 00 0 LAP0 00

INIT Page A
Figure 007

fields default to boxes.
2L - Same as 1L for the ALTN flight plan except there is no flight number entry. If the ALTN CO RTE origin does not match the primary destination, the entry will not be accepted and message "NOT ALLOWED" will be displayed. Entry will not be accepted and dashes displayed here until 1R is complete.
If an alternate destination is defined by the primary destination then it is displayed in 2R and 2L is blanked. If the new primary destination this causes the ALTN F-PLN to be cleared, then fields 2L and 2R change to boxes. If the pilot does not wish to enter an ALTN destination he can enter 0 (zero) into 2L. This causes NONE to be displayed in 2R. If the pilot enters an ALTN destination into 2R then 2L becomes blank. This field is also blanked if any lateral revision (either via the LAT REV page, ACTIVATE SEC on SEC INDEX page, or directly on the F-PLN page) modifies the flight plan defined by the original CO RTE.
An alternate company route number may be entered whenever this field is not dashed (however it will not be accepted if it does not match the primary destination.
This ALTN RTE field can also be filled as a result of a CO RTE selection on the RTE SEL page for the ALTN Flight Plan.
2R - This field displays the ALTN destination. If a preferred ALTN destination is defined by the primary destination. It will be displayed here. This field can also be filled as a result of a valid entry into 2L. Before entry is allowed into this field, the primary destination must be displayed in 1R. Dashes are displayed in 2R until 1R is filled. If the primary destination is not displayed in 1R and an entry is attempted here, message "NOT ALLOWED" is displayed.
Entering a ALTN airport into 2R or pressing LS key 2R with the ALTN displayed (and the scratchpad empty) will change the display to the ROUTE SELECTION page. Any F-PLN revisions that affects the ALTN destination will be reflected in this field. It a F-PLN revision deletes the ALTN destination, then this field is blanked.
3L-3R - LAT and LONG - Upon entry of a company route or FROM/TO in line 1 the LAT/LONG of the origin airport reference point will be displayed here. The pilot may also enter a LAT or LONG via the scratchpad. After entry, LAT will have the slew prompts adjacent to it (in columns 5-6). Pressing the 3R LS key with the scratchpad empty moves the prompts to LONG (in columns 18-19). Pressing 3L with the scratchpad empty will subsequently return the prompts to the LAT field. By pressing the vertical slew keys it will increment or decrement the LAT or LONG (whichever the slew prompt is adjacent to) by .1 minute per key press or .1 minute per second if the vertical slew key is held down.
Only the magnitude of the LAT or LONG is incremented or decremented (regardless of N, S, E, or W). Therefore if 12345.6W is displayed and vertical slewing up is pressed, the LONG should increment to 12345.7W. If 12345.6E is displayed and vertical slewing up is pressed, the LONG should increment to 12345.7E. If the LONG is incremented to 18000.0E (or W), incrementing will no longer be accepted. (However, no message is displayed).

The same is also true if the LAT or LONG is decremented to 0 (N, S, E, or W).
The LAT and/or LONG could also be changed by pilot entry into the appropriate data field.
4L - COST INDEX - . This value may be entered via the CO RTE entry into 1L if the cost index is contained in the company route, or it may be entered or changed by the pilot.
Also the COST index has not been entered prior to entering either ZFW or TOGW on INIT Page B or GW on the FUEL PREDICTION page, it defaults to the previously entered value (last flight) when the pilot inserts ZFW, GW or TOGW. Message "USING COST INDEX" is also displayed alterting the pilot about the default value when the FMC defaults to a cost index. This field defaults to dashes until a CO RTE or FROM/TO entry is made or the COST INDEX is defaulted. If dashed, an entry of CO RTE on FROM/TO causes the field to become boxes except when the CO RTE has a COST INDEX stored with it. The COST INDEX is displayed in large font if entered directly or via a CO RTE entry and small font if a default value. Scratchpad entry into this field is not allowed while it is dashed. Clearing 4L while boxes or a COST INDEX are displayed will cause the default cost INDEX value to be displayed.
4R - ALIGN IRS - Pressing this LS key when ALIGN IRS is displayed initiates IRS alignment. This prompt is displayed in large font when the IRS is in the ALIGN MODE and any one of the following events happen.
Entry of a LAT in 3L (either via a scratchpad).
Entry of a LONG in 3R (either via a scratchpad)
Slew of LAT in 3L or LONG in 3R.
Pressing LS key 4R when the prompt is displayed results in the prompt being blanked.
If the ALIGN IRS prompt is displayed and the INIT page A is left (another MODE key or NEXT PAGE key is pressed) message "ALIGN IRS" will be displayed in the scratchpad.
Message "ALIGN IRS" is also displayed for the following situation. If no IRS is in the ALIGN mode and the INIT page A is accessed, the ALIGN IRS prompt is not displayed even if a position is properly entered in 3L-3R. If a new page is accessed and then an IRS transition into the align mode, message "ALIGN IRS" is displayed. For either case if the INIT page A is reselected and LS key 4R is pressed, this message "ALIGN IRS" is cleared and the ALIGN IRS prompt is removed. The pilot can clear message "ALIGN IRS" using the CLR key. This removes the message from the scratchpad but does not affect the ALIGN IRS prompt if the INIT page A was reselected. The ALIGN IRS prompt in 4R can be cleared by using the CLR function. If the ALIGN IRS prompt is cleared in this way, fields 3L-3R will revert to the previously aligned position or dashes if not previously aligned.
Message "ALIGN IRS" will be automatically deleted if it is displayed when the flight phase transitions from PREFLIGHT.
5L - CRZ FL - Cruise Altitude - This value may be entered via a CO RTE entry into 1L if the CRZ FL is contained in the company route, or it may be entered or changed manually by the pilot. This

field is dashes if no CO RTE or FROM/TO is entered. It becomes boxes if a CO RTE is entered but no CRZ FL is entered (either by pilot or via CO RTE). CRZ FL is always displayed in large font. Scratchpad entry into this field will not be allowed while it is dashed.

5R - TEMP/TROPO - The cruise temperature and tropopause altitude may be entered here. The pilot cannot enter a CRZ TEMP until a CRZ FL is defined. If no CRZ FL has been defined, dashes are displayed. The TEMP defaults to the ISA temperature when the cruise altitude is first entered. If the cruise altitude is changed the cruise temperature changes such that the ΔISA remains the same for the old and the new altitudes. The tropopause altitude defaults to 36090 feet but can be changed by the pilot. Entering a TEMP here is the same as entering one at the T/C. If a TEMP is entered at the T/C on F-PLN Page B or on the VERT REV B pages, the value in this field will also change.

6L - FLT NUMBER - The flight number may be entered here.
The flight number belongs to the flight plan initialization in order to be transmitted to the mode S transponder ATC through the general output bus with the 8-digit format.

6R - CRZ WIND - The cruise wind may be entered here.
The pilot cannot enter a CRZ WIND until a CRZ FL is defined. If no CRZ FL has been defined dashes are displayed.
This value defaults to 0°/0 when CRZ FL is entered. Display is small font for default value and large font for entered data. If a wind is entered at the T/C it is the same as entering it here and the value in this field will change.

In addition to the functions defined above, whenever an entry is made into 1L or 1R, the data displayed on the AIDS page is compared with the effectivity of the active data base.
If the AIDS date is not within the effectivity of the active data base they message "CHECK DATA BASE CYCLE" is displayed. This comparison is performed only if a date is displayed on the AIDS page. This message is automatically cleared if the AIDS date and/or the effectivity of the active data base are subsequently changed so that they coincide.

(b)INIT page B

**ON A/C ALL

(Ref. Fig. 008)

- Access - N/P from INIT A during the DONE flight phase and during the PREFLIGHT phase prior to engine start. If the INIT page B is displayed at engine start then the display changes to the FUEL PREDICTION page. After engine start, page access is not allowed and message "NOT ALLOWED" is displayed.
- Purpose - Allows the flight crew to initialize the aircraft weights and do fuel planning.
- Data Fields

  1L - TAXI - This value defaults to a value specified in the data base but may be altered by the pilot.

  2L - TRIP/TIME - The calculated trip fuel and time are displayed in small font. The pilot may not change these values. Before this can be calculated, aircraft weight and a flight plan must be entered. If a calculated value is not available, then dashes are displayed

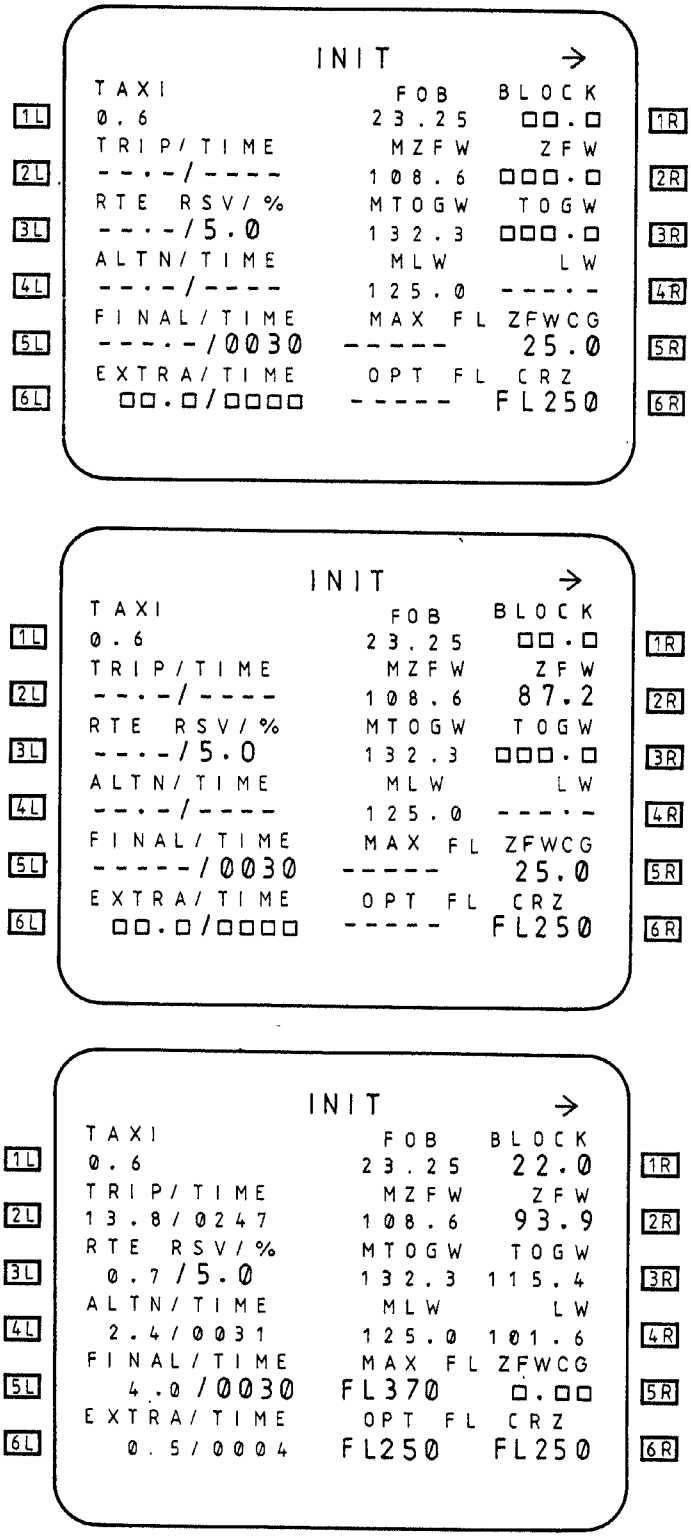
  3L - RTE RSV/% - The trip reserves expressed in weight and percentage of trip fuel. Initially the route reserve defaults to a percentage value defined by the data base. The default value remains displayed until the pilot enters a new value or the pilot enters values of TOGW, ZFW or BLOCK which result in the displayed RTE RSV percentage exceeding the lower or upper limit of RTE RSV defined by the data base. When either limit is exceeded, the limit weight value is displayed in large font and a new percentage is calculated using the limit value of RTE RSV and the trip fuel. This new percentage is displayed in small font. The pilot may alter these values, but only one may be entered at a time. To enter RTE RSV fuel weight, enter the weight via the scratchpad. To enter the percentage of trip fuel, enter a slash and then the percentage. The last one entered will take precedence over the previous one. The entered value will be displayed in large font unless it is limited by the values from the data base.

  4L - ALTN/TIME - the calculated alternate trip fuel and ETE. The pilot may enter this data field as a fuel weight but time can not be entered. Entry format is the same as BLOCK fuel.

  5L - FINAL/TIME - Calculated hold fuel/time over alternate destination. If there is no alternate destination, the hold is at the primary destination. This defaults to a value defined by the data base but may be changed by the pilot. Only one of these values may be entered at a time. The defining parameter will be displayed in large font, the depending parameter in small font.

  6L - EXTRA/TIME - extra fuel reserves and extra time to hold at alternate airport. If there is no alternate flight plan, the hold is at the primary destination.Extra can be entered as fuel weight or time to hold.

  The last one entered will take precedence over the previous one and will be displayed in large font. The dependent one will be displayed in small font. This field defaults initially to boxes, but a pilot



BM5 34 63 00 0 LTR0-00

INIT Page B
Figure 008

entry of BLOCK fuel causes this field to change to dashes.
1R-BLOCK - The total fuel on the A/C at the gate may be entered here. This field defaults initially to boxes, but or pilot entry of EXTRA will cause it to revert to dashes.
The full on board (FOB) is also displayed here in columns 14-18 using the display rules defined for FOB on the FUEL PREDICTION page. These columns are dashed if FOB is not valid for display.

**ON A/C 001-100,

4R - LW - Landing Weight - The calculated landing weight at the primary destination in thousands of kilograms. Pilot entry is not allowed into this field. If a calculated value is not available, then dashes are displayed.

**ON A/C 101-200,

4R - LW - Landing Weight - The calculated landing weight at the primary destination in thousands of pounds. Pilot entry is not allowed into this field. If a calculated value is not available, then dashes are displayed.

**ON A/C ALL

2R - 4R - The MZFW , MTOGW, and MLW are displayed here in small font. They are maximum values for zero fuel weight, take off gross weight and landing weight respectively. The individual values are only displayed when data that would be displayed in the associated field (ZFW, TOGW and LW repectively) exceeds the MZFW, MTOGW or MLW (as appropriate) maximum allowed values.
5R - MAX FL - The present calculated maximum flight level is displayed here to the nearest 100 feet. The displayed value defaults to dashes if a calculated value is not available.
5R-ZFWCG-ZERO Fuel Weight Center of Gravity.
ZFWCG must be entered by the pilot. If it has not been entered at engine start, the scratchpad displays : "INITIALE ZFWCG".
This message is automatically cleared when ZFWCG is entered.
ZFWCG cleared at the transition to the DONE flight phase.
6R - OPT FL - The calculated present optimum flight level is displayed here to the nearest 100 feet. This field defaults to dashes if a calculated value is not available.
6R - CRZ - The cruise flight level is displayed here and may be entered or changed by the pilot. Entry is not allowed when it is dashed.
Certain inputs are necessary before fuel planning can be done. Figure shows the INIT Page B when first accessed (blank). Here the EXTRA, BLOCK, ZFW, and TOGW entries are boxes indicating that these entries should be made. (Figure shows the page after the ZFW has been entered). The possible entry combinations are :
ZFW and BLOCK,
ZFW and TOGW,

TOGW and BLOCK,
TOGW and EXTRA,
ZFW and EXTRA.

When any of the first three combinations has been entered, any remaining boxes revert to dashes and the system calculates and displays ZFW, block or TOGW (whichever not entered). Calculation of remaining fuel parameters requires the pilot entry of flight plan and cruise flight level. For the last two combinations the remaining boxes also revert to dashes but no fuel parameters are calculated until the flight plan and cruise flight level are pilot entered.

An entry of ZFW or TOGW may also cause the Cost Index to default.

If an entry is out of the allowable entry range, then the field remains unchanged the scratchpad message "ENTRY OUT OF RANGE" is displayed, and the maximum value field is displayed for ZFW or TOGW if the entry exceeds the maximum value.

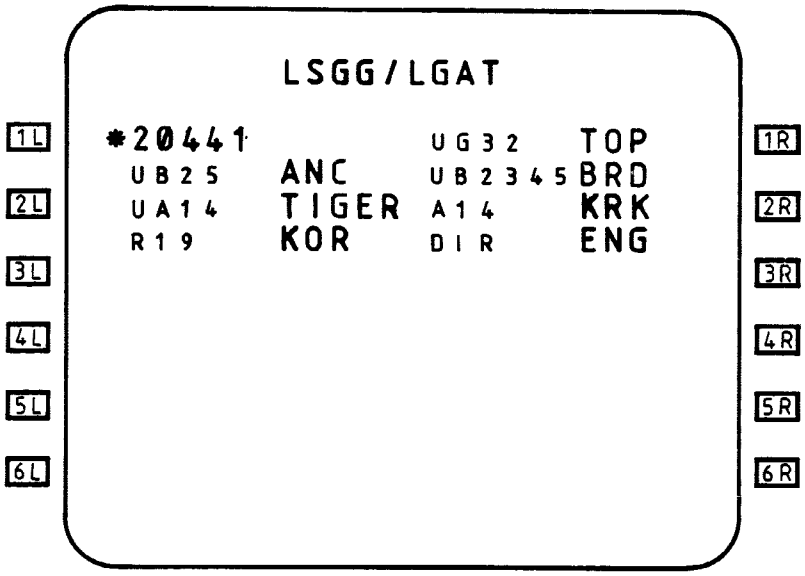
If the calculated dependent weights exceed the minimum or maximum allowed, then the combination entries and the calculated out of range weight continue to be displayed but message "WEIGHT LIMIT EXCEEDED" is also displayed and the maximum value field is shown for ZFW, LW or TOGW if the calculated value exceeds the maximum value. A subsequent entry within allowed range or causing a calculated parameter to be in range causes the maximum value display to be removed. If a third entry is made, the first two entries are erased and the fuel weight calculations are terminated. The erased fields revert to boxes except for a third entry of block or extra which causes reversion to boxed fields except for dashes in 6L or 1R respectively.

The entries in 1L, 3L, 4L, and 5L may be made at any time and do not erase entries in other fields. They merely restart the fuel planning calculations. CG and CRZ FL entries also restart the fuel planning calculations.

The following figure shows the INIT page B with the extra and ZFW fields entered.

The MZFW, MTOGW and MLW fields are included in these figures for reference only.

(c)RTE SELECTION page
(Ref. Fig. 009)
Access - Enter an airport pair as FROM/TO on INIT Page A 1R.
Enter an airport as an ALTN destination on INIT A page (2R).
LS key 1R on INIT A page with airport pair displayed as FROM/TO, and scratchpad empty. LS key 2R on INIT A page with an airport displayed as ALTN destination and scratchpad empty.
If the RTE SELECTION page is displayed, when the flight phase transitions from PREFLIGHT and it was accessed from the INIT A page, the display changes to the F-PLN A page.
Enter an airport pair as FROM/TO on SEC INDEX page (1R) LS key 1R on SEC INDEX page with airport pair displayed as FROM/TO and scratchpad empty.
- Purpose - Allows the flight crew to inspect the various company routes in the data base between two airports and select a route.
- Data Fields
  Title - Columns 8-16 contain the airport pair that defines the origin and destination of the F-PLN. When accessed via LS key 1R on INIT page A, this field defines the origin and destination of the active primary F-PLN. When accessed via LS key 2R on INIT page A, this field defines the origin and destination of the ALTN F-PLN. When accessed via LS key 1R on the SEC INDEX page, this field defines the origin and destination of the secondary primary F-PLN. The upper right hand corner indicates how many CO RTEs are available (in columns 21-22, left justified) and which one is displayed (columns 18-19 right justified).
  1L - The CO RTE number of available data base company route between the airport pair in the title line. The company routes are listed on subsequent pages as they appear in the data base.
  If no CO RTE are available then NONE is displayed in large font in columns 1-4
  The various elements of the company route are displayed (left to right) in fixed fields in line 1L through 5L. Columns 1 and 13 are blank except for the CO RTE number line (1L). Table 15 shows the items that may be listed and the manner in which they are displayed. The individual elements are displayed left justified in the fixed fields. The procedure or airway name and the DIR of direct leg are displayed in small font and all waypoints are displayed in large font. Vertical slewing is available on this page when all the company route elements do not fit on one display. Each vertical slew moves the display of the CO RTE elements by one line pair. The CO RTE number remains in 1L during vertical slewing.
  6L - INSERT - Pressing this LS key inserts the displayed CO RTE into the F-PLN and changes the page to the INIT A page. This prompt is not displayed if there are no available CO RTES.
  6R - RETURN - Pressing this LS key returns the display to the INIT page A.



BM5 34 63 00 0 CGMO

Route Selection
Figure 009

TABLE 3
DATA ELEMENT CDU DISPLAYS

Optional Data Element	CDU Display
SID	PPPPPP WPT
SID ENROUTE TRANSITION	PPPPPP WPT
STAR ENROUTE TRANSITION	PPPPPP WPT
STAR	PPPPPP WPT
APPROACH	PPPPPP WPT
AIRWAY	PPPPPP WPT
Initial Fix	IFWPT
Direct Leg	DIR WPT

NOTES :
(1) PPPPPP is a procedure or airway name.
(2) WPT is the ending waypoint on the procedure, airway, or direct leg.

(8)MODE key
MODE SELECT
(Ref. Fig. 010)

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

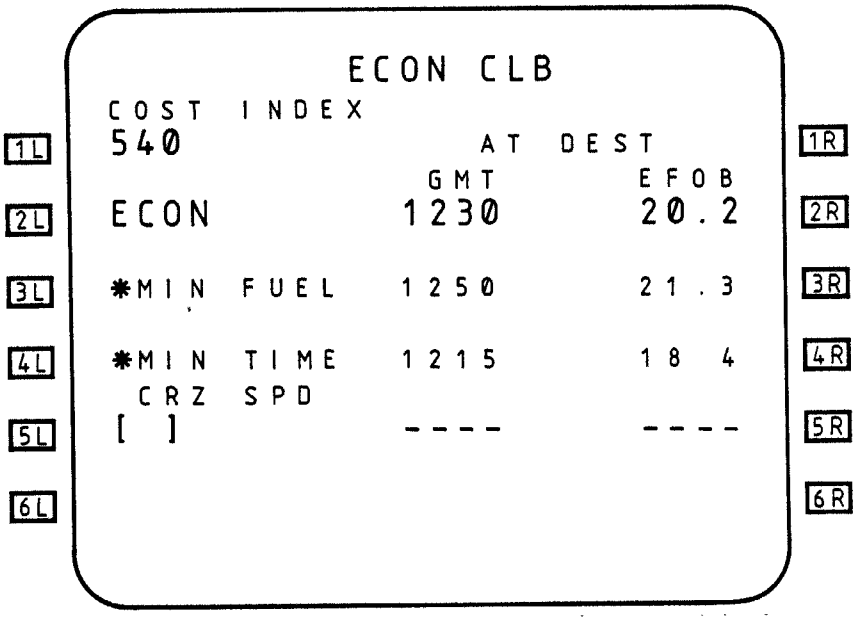
R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 011)

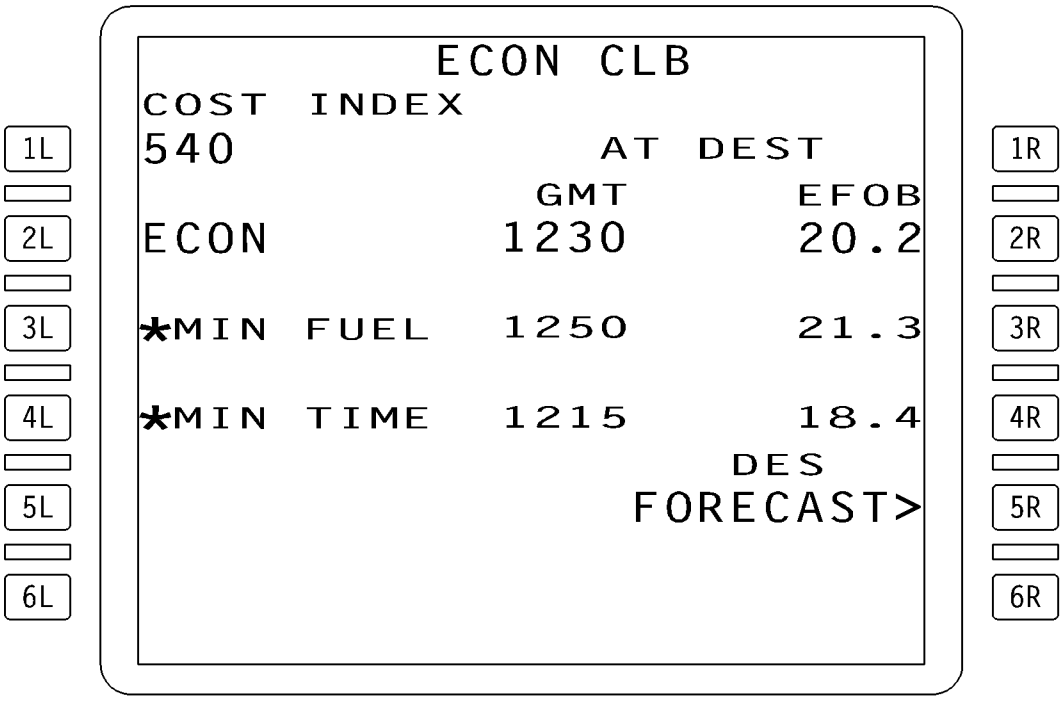
**ON A/C ALL

Access - MODE key on CDU face
MODE LS key on SEC INDEX page
- Purpose - Allow predictions for time and fuel at destination for the strategic performance modes. Activate strategic modes.
- Data Field
The current performance mode (including tactical and situational modes is displayed in the title line right justified in columns 6 through 13. These performance modes are identical to the modes in the title line of the progress page.
In columns 15 through 17 the vertical phase is displayed. The following vertical phases will be displayed :
CLB will be displayed if the aircraft is in the DONE, PREFLIGHT, TAKEOFF, or CLB phase.
CRZ will be displayed if the aircraft is in the CRZ phase.
DES will be displayed if the aircraft is in the DES or APPR phase.
The mode displayed in the title may be different from that displayed in large font in lines 2L through 4L. This is because the title can contain tactical and situational modes, whereas line 2L through 4L can contain only strategic modes.
1L-COST INDEX. The cost Index from INIT page A is presented here. the pilot can modify it. This field is identical to COST INDEX on the INIT page A.
If dashes are being displayed when the flight phase transitions from PREFLIGHT or DONE to TAKE OFF or CLB, then the field changes to display boxes, thereby allowing entry of a COST INDEX.
2L-4L, 2R-4R- Displays the strategic modes and the predicted time and fuel remaining at destination for each of the modes. When time prediction are ETA, columns 12-15 of the label line of 2R displays GMT (right justified). When predictions are ETE the same field



BM5 34 63 00 0 CHMO

Mode Select
Figure 010



BM5 34 63 00 0 FBM0 00

Mode Select
Figure 011

displays **TIME**. The selected strategic mode and associated predictions are displayed in large font while the non-selected modes and their predictions are diplayed in small font. Pressing the **LS** key along side a mode will activate that mode. Activation of a tactical mode on the **TACT MODE** page does not affect the display of the selected strategic mode.

5L-CRZ SPD. This field and its associated prediction fields are displayed during the **PREFLIGHT, T/O, CLB** and **CRZ** flight phases and only if a valid **CRZ ALT** exists. The pilot can enter a cruise speed in this field to enable predictions based on flying that **SPD** at the **CRZ ALT**. This is for predictions only and the **SPD** mode cannot be selected on this page. Consequently, this field and the associated predictions are always displayed in small font even if the **SPD** mode is active.

Prior to pilot entry, brackets are displayed and the predictions fields are dashed. Entry into this field may be **SPD** or **MACH**. Any pilot entry into the **SPD** field on the **CRZ TACT MODE** page would also be reflected here. When the **SPD** mode is active, an entry into this field is not allowed. Any pilot entered **CRZ SPD** is cleared on transition to the **DES** phase ; so that if the conditions specified above are subsequently satisfied, the field will reappear with brackets displayed.

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

5R-DES FORECAST prompt : provides access to the **DES FORECAST** page for the active **F-PLN**.

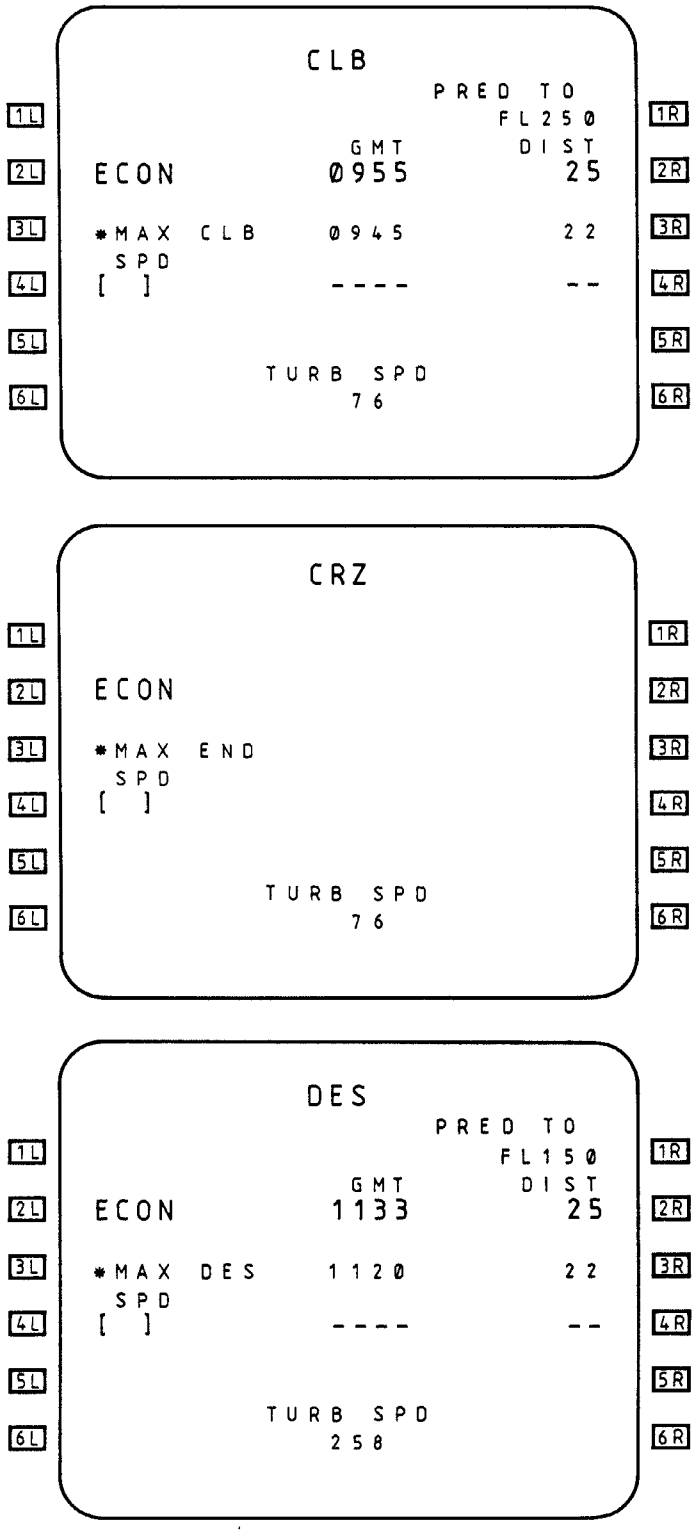
**ON A/C ALL

(9)TACT MODE key

TACTICAL MODES

(Ref. Fig. 012)

- ACCESS - TACT MODE key on CDU face. When this key is pressed an appropriate page is displayed depending on flight phase :
  CLB when in DONE, PREFLIGHT, TAKE-OFF or CLB flight phase.
  CRZ when in the CRZ flight phase.
  DES when in the DES or APPR flight phase.
- Purpose
  In CLB and in DES time and distance predictions to an altitude are given for the selected strategic mode and two tactical modes (max climb or max descent and manual speed). The pilot can activate one tactical mode.
  In CRZ only activation (without prediction) is possible for maximum endurance or manual speed.
- General rules
  Selection of a tactical mode is only possible for the present flight phase.
  Once a tactical mode is selected, it is active for the entire present flight phase unless another mode is selected on the tactical mode page.
  At the end of the flight phase, the FMS goes back to the selected strategic mode without pilot action.
  Selection of a tactical mode does not change any other page except the title line on mode page and the predictions.
- Data fields
  Line 1R - (CLB or DES)PRED TO -
  The altitude to which the predictions are referenced. Without a pilot entry this defaults to CLR ALT. Any pilot entry is maintained on subsequent page accesses until the aircraft altitude is below the entered altitude or the field is cleared (using the CLR key). In both cases, the CLR ALT would again be displayed. An entry into this field does not affect the CLB or DES Page.
  Line 2L-4L, 2R-4R (CLB or DES)
  Displays the selected strategic mode and the available tactical modes with the predicted time and distance to the altitude contained In 1R. When the time predictions are ETA, columns 12-15 of the label line of 2R display GMT (right justified). When predictions are ETE, the same field displays TIME.
  Line 2L-4L (CRZ)
  Displays the active strategic mode and the available tactical modes.
  Line 2L.
  The selected strategic mode is displayed here. If no tactical mode has been selected, then the selected strategic mode and the associated predictions are displayed in large font. If a tactical mode is selected, then the selected strategic mode (and predicitons) is displayed in small font. The tactical mode can subsequently be cancelled by pressing 2L, thus reverting this display to large font. Selection of a new strategic mode on the MODE Page is reflected here. If a tactical mode is already active then the new strategic mode is displayed in small font.
  Line 3L - MAX CLB (when CLB)
  MAX END (when CRZ)



BM5 34 63 00 0 LCM0 00

Tactical Modes
Figure 012

MAX DES (when DES)

Pressing this LS key will activate the MAX climb (or Endurance or Descent) tactical mode. When this mode is active, this field and the associated predictions are displayed in large font. When non-active they are displayed in small font.

Line 4L - SPD - (CLB).

The SPD Mode cannot be activated until a speed has been entered. Prior to pilot entry, brackets are displayed and the prediction fields are dashed. If the SPD mode is not active then any entry into this field is displayed in small font with a star (Ref. Fig. 012). The SPD Mode may then be activated by pressing this LS key which causes the speed and associated predictions to be displayed on large font. If a new speed is entered while the SPD Mode is active, then this will be displayed in large font. Any entry into this field does not affect the CRZ and DES pages.

Entry into this field may be SPD, MACH, SPD/MACH or MACH/SPD. A single entry (SPD or MACH) is displayed in columns 1-3 without a slash (/). A double entry (SPD/MACH or MACH/SPD) is displayed as SPD/MACH in columns 1-7. A SPD or MACH entry replaces completely any previous SPD/MACH entry.

Line 4L - SPD (CRZ)

Display logic is the same as CLB page, but entry of only SPD or MACH is allowed. Any entry into this field does not affect the CLB and DES pages

Line 4L - SPD (DES)

As CLB page any entry into this field does not affect the CLB and CRZ pages.

Line 6L - 6R - TURB SPD

The turbulence speed is displayed in columns 12-14. It is for advisory purposes only and cannot be changed by pilot entry.

(10)Flight plan (F-PLN) key

(a)General

The F-PLN key allows the crew to view the lateral and vertical elements of the flight plan in the sequence in which they occur. It also allows lateral and vertical revisions to be made to the existing flight plan. The following discussions (LEGS, vertical slewing, and horizontal slewing) pertain to both Flight Plan Pages A and B.

1 LEGS Definition

- These are defined by two lines on the CDU (label and data line). The label line may contain up to nine characters, and the data line may contain up to seven characters.
- The first of two lines contains the path defining the leg such as an airway, SID, STAR, heading, course, etc. If this line is blank, a Direct leg is assumed. If the data are in parentheses it is a pseudo waypoint.
- The second of two lines contains the termination of the leg. The data in this line may be in parentheses, indicating that the waypoint is a pseudo waypoint.
- Conditional legs - When conditional legs exist, both legs will be displayed on the flight plan pages. The leg that the FMC predicts will be flown is displayed with performance predictions adjacent to the waypoint. The termination that the FMC predicts will not be flown will be displayed with CONDITIONAL entered in columns 14 through 24 adjacent to the waypoint.
  For downpath conditional legs, performance predictions are used to determine the leg that will be flown. When the conditional leg is the active or next leg, then guidance determines the leg that will be flown.
  The conditional altitude termination will be displayed as the first of the two legs.
  NOTE 1 : The only special case is the display of an HM leg which requires two data lines. For lateral F-PLN stringing purposes the two associated LS keys are operationaly identical.
- A fixed waypoint may or may not be overflown. If it is going to be overflown a triangle will follow the fixed waypoint identifier. Only legs with the overfly character indicating an overfly and that end in a fixed waypoint will be displayed with the triangle.
- A leg may have a specified turn direction associated with it. If a turn direction is specified on a leg where this parameter is optional, then a large font arrow indicating the direction (<---- Left, ----> Right) is displayed along side the lateral termination prior to the leg with the specified turn direction. The display of turn direction takes precedence over the display of the overfly character.
- The flight plan contains both lateral and vertical information in sequence as the FMC predicts that they will happen. The following four subsections contain all of the entries that are allowed on the left side of the flight plan pages except for messages that may appear in line six.

Lateral Defining Legs - Paragraph 2A (3)(b) defines all of the lateral defining legs that may appear on the CDU as well as the type of leg. WPT is any waypoint name.

Pseudo Waypoints - Pseudo waypoints are in the flight plan for pilot reference only and cannot be displayed as the FROM waypoint. These waypoints do not cause any lateral path changes to the aircraft. However, they signify when a vertical occurrence will happen in relation to the lateral flight plan. Paragraph 2A (3)(a) defines all the pseudo waypoints that may appear in the flight plan with definitions for each one. All pseudo waypoints are contained in parentheses.

NOTE : The pseudo WPTs acceleration altitude and thrust reduction altitude are only presented on T.O page.

The pilot may enter any altitude as the altitude intercept point. It will be entered in climb if the aircraft is in the DONE, PREFLIGHT, TAKEOFF, or CLIMB flight phase, and it will be entered in descent if the aircraft is in the CRZ, DES, or APPR phase of the flight.

All predictions on F-PLN Page A are available for all pseudo waypoints. On F-PLN Page B only distance is available except for T/C and T/D where all predictions are available.

The following pseudo waypoints can be cleared via the CLR key on the right or left LS key.

(S/C)
(S/D)
(HHHHH)
(AA-NN)

The Speed Limit pseudo waypoint may be cleared (deleted) using the LLS key, but using the CLR and the RLS key causes the speed limit to default to 250/10000.

All other pseudo waypoints are not affected by the CLR function.

Markers - Certain things within the FMS must be clearly marked to be obvious to the flight crew. The following table contains the markers that can be displayed in the F-PLN page. The markers are displayed in the data line.

If no F-PLN is defined the flight plan page appears with P POS and END of F-PLN

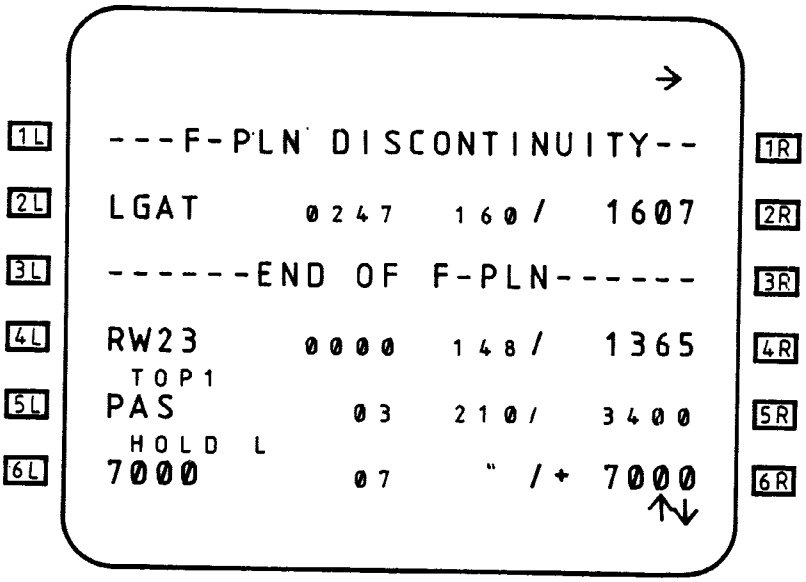
TABLE 4
F-PLN MARKERS

CDU Display	Definition	Access to LAT REV	Access to VERT REV	CLR function Available
F-PLN DISCONTINUITY	Indicates there is a discontinuity between legs of the flight plan.	Yes	No	Yes
END OF F-PLN	Indicates the end of the active of secondary flight plan, whichever is displayed	No	No	No
END OF ALTN F-PLN	Indicates the end of the alternate flight plan.	No	No	No
NO ALTN F-PLN	Indicates that there is no alternate flight plan.	No	No	No
CONFIRM -EOSID- CLEAR	Indicates the beginning of the EOSID. The pilot can confirm or clear the SID with the LS key.	No	No	No

2 Vertical Slewing
The flight plan pages normally appear with the FROM waypoint at the top of the page. To scan through the flight plan the pilot uses the vertical-slew keys. These keys enable the pilot to look at any segment in the flight plan, and to display any segment on the EFIS because the EFIS display can be referenced to the F-PLN pages.
The flight plan is a closed loop (Ref. Fig. 013) display. This means that in the display the FROM waypoint follows the ALTN destination. If the vertical-slew key is pressed enough times to scroll the display beyond the ALTN destination, the FROM waypoint will be displayed following the ALTN destination.
The vertical slew keys slew F-PLN page one waypoint at a time except when the FROM WPT is displayed at the top of the page and the down slew key is pressed.
The F-PLN pages are automatically slewed when a leg switch occurs if the FROM waypoint is at the top of the page. However, a pseudo waypoint or marker may not scroll into the FROM waypoint if it is crossed. Instead, the FROM waypoint remains as it is, and the pseudo waypoint is no longer displayed.
When slewing is available up and/or down will appear in columns 23 and 24 in the scratchpad line.

3 Horizontal Slewing (Next Page)
There are two pages to each flight plan, each containing the waypoints, but different information about the waypoints. When the F-PLN key is pressed the F-PLN page A is displayed. To get access to page B, the NEXT PAGE key is used. The two pages are a closed loop so continuous button pushes alternate between them. When horizontal slewing is available, an arrow will be displayed in column 23 of the title line.

4 Waypoint orientation
The waypoint orientation on the F.PLN pages is dependent on the way in which the page is accessed and the effect of flight plan revisions either directly on the page or via the lateral revision functions. The table below defines the waypoint orientation for each type of page access.



BM5 34 63 00 0 ANMO

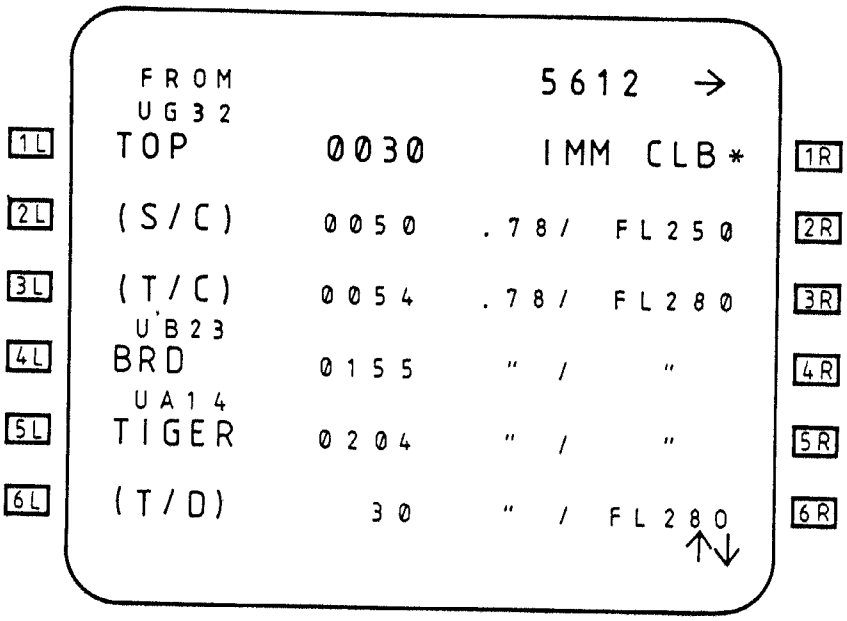
Closed Loop Flight Plan Display
Figure 013

TABLE 5
WAYPOINT ORIENTATION

ACCESS	WAYPOINT ORIENTATION
F-PLN key	FROM waypoint In 1L
Entry of Fixed waypoint on DIR to page	FROM waypoint in 1L
Next Page	Same orientation as previously displayed page
Reversion from lateral or vertical revise pages	FROM waypoint in 1L
Insertion of lateral revision	Position of revise point remains unchanged*
Use of "RETURN" from lateral revise pages	Position of revise point remains unchanged*
Insertion of vertical revision	Position of first lateral leg on previously displayed page remains unchanged*
Use of "RETURN" from vertical revise pages	Position of revise point remains unchanged*
Direct lateral revision	Position of waypoints up to revision remains unchanged
Direct vertical revision	Position of first lateral leg on previously displayed page remains unchanged*

* Use of these rules should not cause or allow the FROM waypoint to be moved from 1L (or above if slewed) to below 1L when the F-PLN page is redisplayed. If this is the case, then the F-PLN page should be re-oriented to display the FROM waypoint in 1L. Furthermore, if the FROM waypoint was in 1L when the F-PLN page was left, then the FROM waypoint will be in 1L when the F-PLN page is redisplayed.

SITUATIONAL MODE, IMM EXIT and RESUME HOLD prompts. When available for selection, the situational mode, IMM EXIT and RESUME HOLD prompts are displayed right-justified in line 1R of both F-PLN pages irrespective of vertical slewing. This suppresses the display in 1R of SPD/ALT on the F-PLN page A (Ref. Fig. 014) and TEMP/WIND on the F-PLN page B. On the F-PLN page B the labels in 1R (°C and WIND) are maintened, except in the case of RESUME HOLD. The display protocol for these prompts and the result of pushing the associated line select key is defined in table 6.



8M5 34 63 00 0 APJO

Situational Command (F-PLNA)
Figure 014

TABLE 6

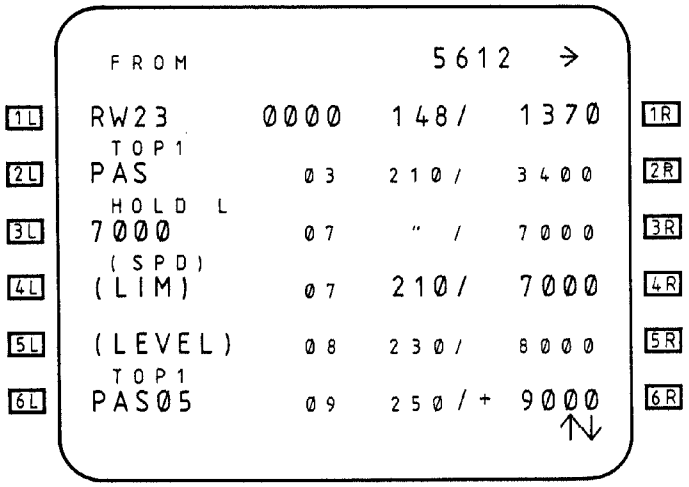
DISPLAY	WHEN DISPLAYED	RESULT OF LS KEY PUSH
DECEL*	When DECEL mode is available :	Selects DECEL mode. 1R reverts
IMM CLB*	When IMM CLB mode is available	Initiates step climb immediately. 1R reverts to normal display
IMM DES*	When IMM DES mode is available	Initiates immediate descent. 1R displays selected vertical speed (see below)
V/S = - NNNN where : NNNN is selected vertical speed displayed in large font. It is always displayed as a negative number, right justified with leading zeros suppressed.	When IMM DES mode is active and the IMM EXIT prompt is not displayed	NNNN defaults to 1000 fpm but may be changed via the scratchpad. Use of CLR key reverts to default value.
(1) IMM EXIT*	During deceleration to the holding fix or when the HM leg is active	Activates IMM EXIT function
(1) RESUME HOLD*	When IMM EXIT is selected. If RESUME HOLD is not pressed this prompt remains displayed until the next leg becomes active.	Cancels IMM EXIT function, and reinserts hold. 1R reverts to IMM EXIT prompt.

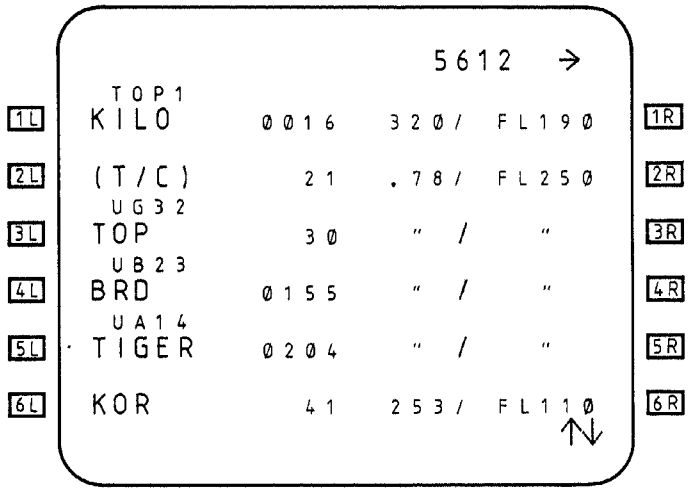
(1)IMM CLB and IMM DES have priority for display over this prompt. If IMM CLB or IMM DES is then selected. IMM EXIT or RESUME HOLD is displayed.

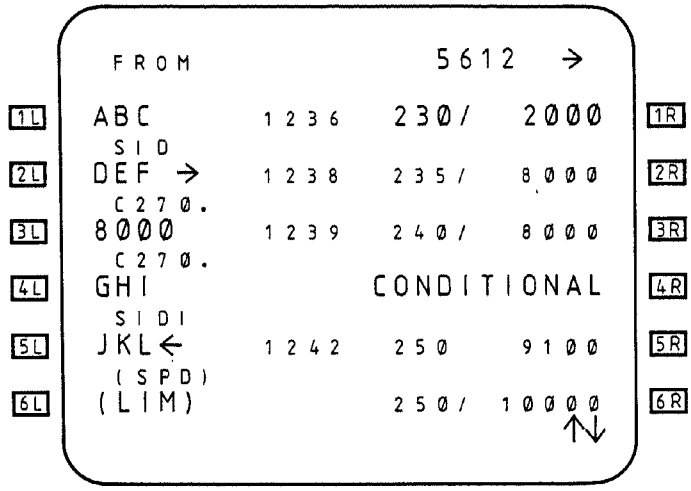
(b)F-PLN page A (Ref. Fig. 015)
(A display with a conditional termination and overflying waypoint JKL is also shown).

1 Description

- Access - F-PLN key on CDU face.
  NEXT PAGE from F-PLN Page B.
  Return from any revise page if this page was used for access to that revise page.
  If the INIT A or RTE SELECTION page is displayed when the flight phase transitions from PREFLIGHT or DONE to TAKE OFF, CLB, CRZ, DES or APPR.
  If a Maintenance page (MAINT, TEST PATTERN, or KEY TEST) is displayed when the flight phase transitions from PREFLIGHT or DONE to TAKE OFF, CLB, CRZ, DES or APPR.
- Purpose - display flight plan and time, speed and altitude, waypoint by-waypoint throughout the flight plan and allow selection of situational modes when available.
- Data fields - Title - The flight number as entered on the INIT page A is displayed in large FONT in column 17-20. If no flight number had been entered on the INIT page A, then this field is blank
- 1L-6L - Along the left of the page, waypoints and legs are displayed The waypoint and leg field is in columns 1 through 9 of the label line and columns 1 through 7 of the data line. The markers are displayed in the entire data line.
  The time, speed, and altitude displays for the FROM waypoint are actual memorized parameters, not predicted, and are displayed in large font. They are memorized at the time a new active leg is defined either by a leg sequence or by clearing the FROM waypoint.
  The altitude is displayed to the nearest 100 feet. When PPOS is the FROM waypoint, dashes (---) will be displayed for time speed and altitude.
  If the FROM waypoint is the origin, the speed displayed is V1 as entered on the TAKEOFF page or dashes if V1 is not defined - the altitude displayed is the airport or runway elevation rounded to the nearest 10 feet.
  Adjacent to a waypoint, the time at which the aircraft passes that waypoint is displayed in columns 9 through 12 as HHMM (HH is hours, MM is minutes and leading zeros may be omitted on hours but not on minutes). For predicted times, the hours are not displayed on successive lines unless they change ; however, they must be displayed in line 1L - 1R and when displaying a time constraint.
  Adjacent to the time is the speed (CAS or MACH) at which the aircraft passes the waypoint. The speed is normally FMC-predicted but a speed constraint (CAS) may be entered at a waypoint.
  The speed is displayed in columns 15 through 17 as NNN for speed and .NN for Mach. If the predicted speed does not change on successive legs a ditto will be displayed.
  Speed constraints are always displayed. The speed must also be displayed in line 1L-1R.







F-PLN Page A with Conditional Termination
Figure 015

Adjacent to the speed, the calculated or constrained altitude while crossing the waypoint is displayed ; a plus in column 19 represents **AT** or **ABOVE** and a minus is **AT** or **BELOW**. The altitude constraint may be a constraint window (both an **AT** or **ABOVE** and an **AT** or **BELOW** constraint). Only one of the altitudes for an altitude window constraint can be displayed. Normally the lower altitude will be displayed, but the upper altitude will be displayed if it is predicted to limit the aircraft path. In the following figure, paths 1 and 2 will result in the lower altitude being displayed. Predicted path 3 will result in the upper altitude being displayed.

(Ref. Fig. 016)

The predicted altitudes are displayed as **NNNOO** (baro corrected altitude rounded off the nearest 100 feet) for altitudes below the transition altitude and as **FLNNN** (pressure altitude) for altitudes above the transition altitude. Pilot entered altitude constraints are displayed in the same format as entered, regardless of the transition altitude. Constraints entered as an altitude are rounded to the nearest 10 ft.

This altitude is displayed in columns 20 through 24.

If the predicted altitude does not change from waypoint to waypoint, ditto marks are displayed on successive waypoints.

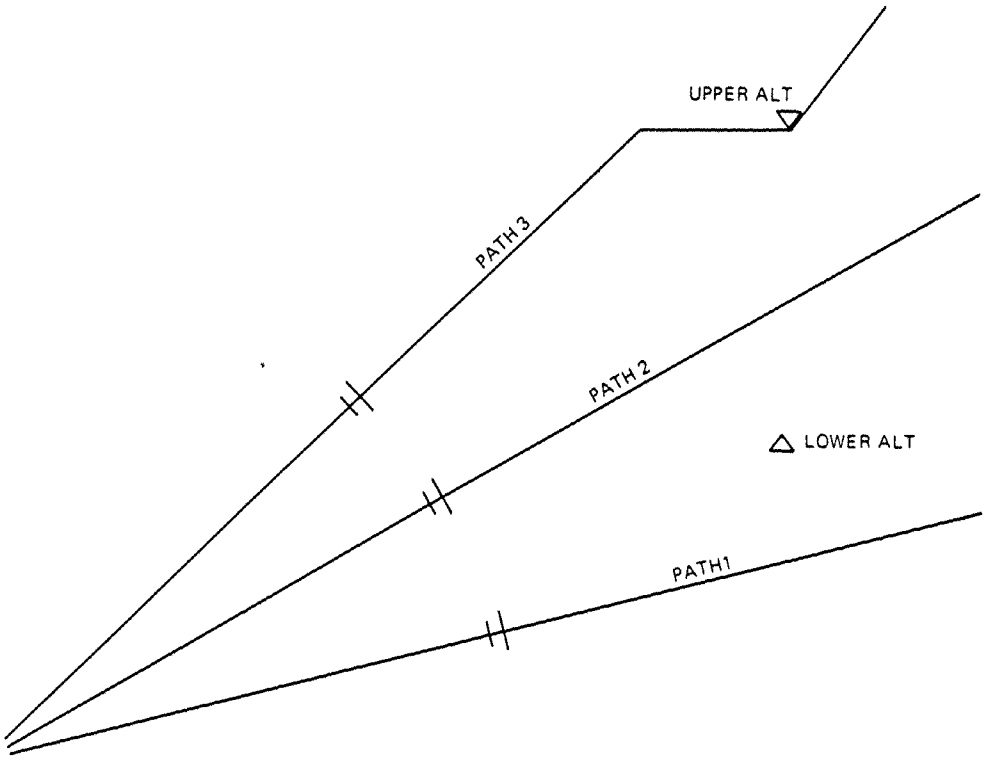
Altitude constraints are always displayed.

The altitude must also be displayed in line 1L-1R.

FPA - The Flight Path Angle is displayed in columns 21 through 24 of the label line (above altitude) if an entered terminal area procedure defines the **FPA** to be flown. The **FPA** will be displayed as **N.N**^{o} in degrees. The cruise altitude for the active primary flight plan is entered on the ground via the **INIT A** or **B** pages.

To change the cruise altitude for the primary or alternate flight plan, enter the new cruise altitude as a constraint at the **T/C** or **T/D** pseudo waypoints. For the active primary flight plan the cruise altitude can also be changed on the **PROGRESS** page.

A waypoint may be entered (resulting in a direct leg) directly on the flight plan page by entering the waypoint into the scratchpad and pressing the left **LS** key at the point the waypoint is to be inserted.



BM5 34 63 00 0 AOMO

Predicted Paths Versus Altitude Display
Figure 016

2 Constraints

Normally the time, speed, and altitude parameters on F-PLN Page A are predicted by the FMS ; however, these values can be constrained. The constraint may be part of a terminal area procedure that has been entered from the data base or it may be entered by the pilot. The pilot may alter any previously entered constraint by another constraint entry or clearing of the constraint. Constraints are displayed in large font while normal performance prediction displays are small font.

TABLE 7
ALLOWABLE CONSTRAINTS

CLB	CRZ	DES
Time (AT)	Time (AT)	Time (AT)
Speed (AT OR BELOW)		Speed (AT OR BELOW)
AT Altitude		AT Altitude
AT or BELOW Altitude		AT or BELOW Altitude
AT or ABOVE Altitude		AT or ABOVE Altitude

There are two ways to enter and delete speed and altitude constraints.

- Directly on F-PLN Page A.

The constraint is entered into the scratchpad and then by pressing the RLS key next to a waypoint the constraint is entered into that line. The format that must be used is SPD/ALT ; however trailing slashes may be omitted. If no value is entered for a constraint, the FMS assumes there is no constraint on that parameter. Speed constraints may be entered as CAS (NNN) only. Altitude constraints may be entered as an altitude or as a flight level.

EXAMPLES :

SPD - Enter only speed constraint.
/ALT - Enter only altitude constraint.
SPD/ALT - Enter speed and altitude constraint.

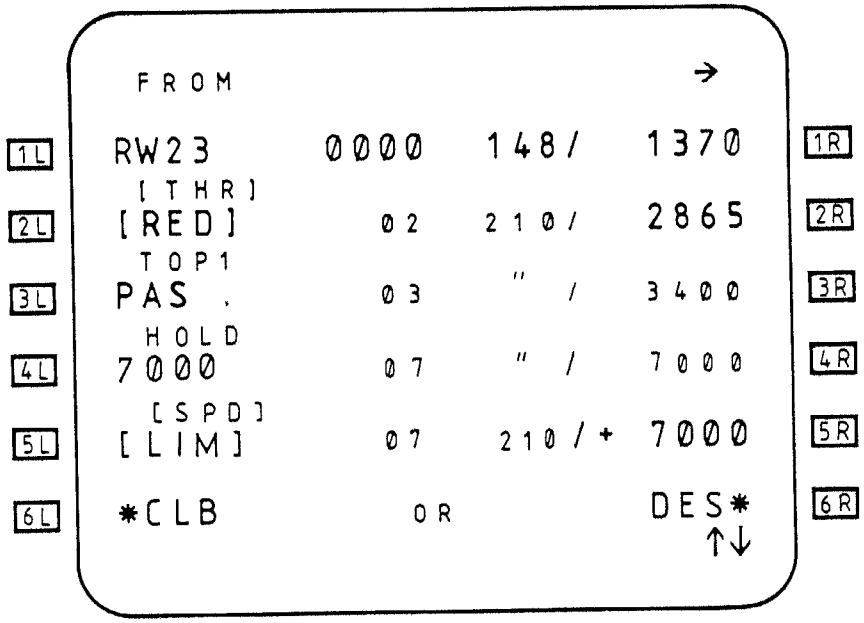
A constraint may be cleared using the CLR function. All constraints (including time) on that line are deleted when the CLR function is used.

Constraints cannot be entered at the FROM waypoint ; any such attempt will result in message "NOT ALLOWED" being displayed

If an ALT or SPD constraint is entered by the pilot at a CRZ waypoint (between T/C and T/D) or at any waypoint before the T/C and T/D are calculated, a *CLB OR DES* prompt will be displayed in line 6L-6R. The pilot must choose CLB or DES by pressing the appropriate LS key before the FMC can accept the constraint into the flight plan. Choosing CLB or DES inserts the constraint and changes line 6L-6R to redisplay what was there before the constraint entry. If the aircraft is in the DES or CRZ phase and the entry is in the active primary flight plan, assume the constraint is in DES. (Ref. Fig. 017)

If F-PLN Page A is exited before choosing CLB or DES, the prompt will not longer be displayed on the new page and the constraint will not be entered into the flight plan.

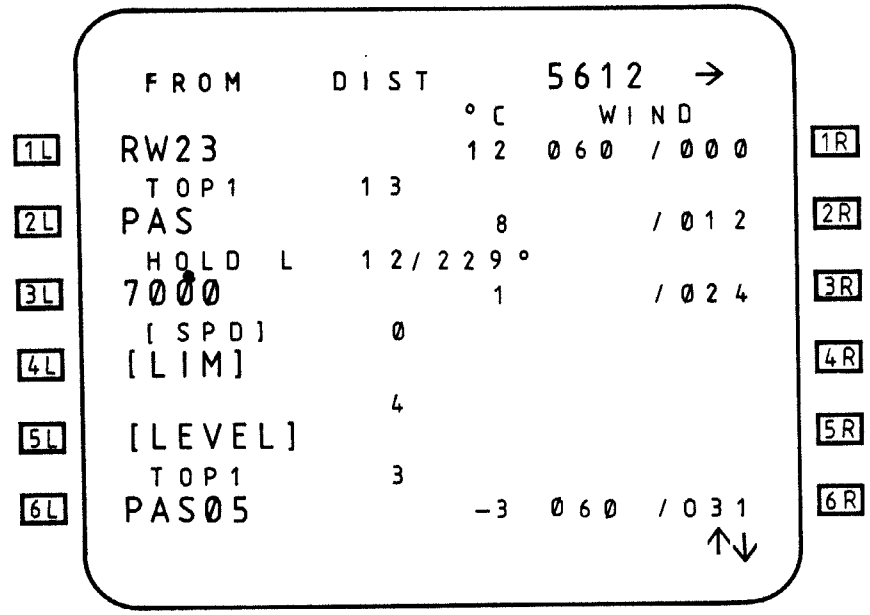
- On VERT REV Page A.
  This page contains data fields for entering and deleting each type of constraint (time constraint may be entered here). There are individual prompts for each type of constraint to avoid any confusion that might exist as to which constraint is being entered or cleared.

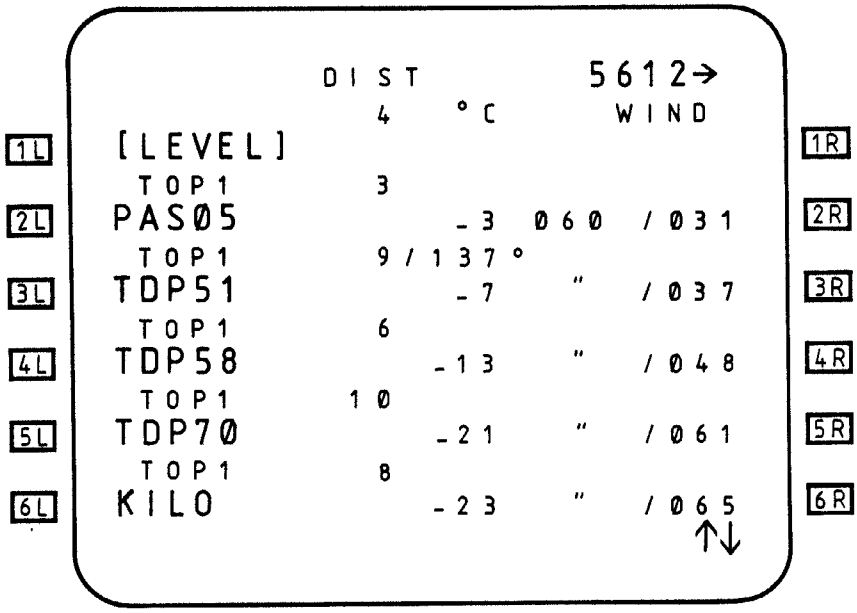


BM5 34 63 00 0 ARMO

Constraint Entry (F-PLN A)
Figure 017

(c)F-PLN page B
(Ref. Fig. 018)
1 Description
- Access - NEXT PAGE from F-PLN Page A
  Return from any revise page if this page was used for access to the revise page.
- Purpose - Display the flight plan with temperature, wind, and distance displayed and allow the selection of situational mode where available.
- Data Fields
  Title - The flight number as entered on the INIT A page is displayed in large font in columms 17 - 20. If no flight number had been entered on the INIT Page A, then this field is blank.
  1L-6L - Pseudo waypoints, lateral defining legs, and markers are displayed along the left side of the page. This field is columns 1 through 9 of the label line and 1 through 7 of the data lines for pseudo waypoints and lateral defining leg. The entire data line is used for the markers.
  1L - Before any vertical slewing the FROM waypoint will be displayed here.
  °C - The forecast temperature at each waypoint is displayed for pilot reference. The TEMP for the FROM waypoint is the actual memorized temperature at that waypoint. It is memorized at the time a new active leg is defined either by a leg sequence or by clearing the FROM waypoint. If the FROM waypoint is PPOS, dashes are displayed. If the FROM waypoint is the origin airport, then the forecast value is displayed. Temperature, in °C, is shown as ±NN (may be a single number). Entry is only allowed in the cruise phase (at fixed waypoints, at the origin, and at the destination). The temperature field is columns 13 through 15 and is displayed in large font if it is pilot entered or actual and small font if predicted or default value.
  Temperature is displayed at the T/C and T/D but not at any other pseudo waypoint.
  WIND DIRECTION/MAGNITUDE - The forecast wind based on pilot entries is displayed for each waypoint. The wind for the FROM waypoint is the actual memorized wind at that waypoint. It is memorized at the time a new active leg is defined either by a leg sequence or by clearing the FROM waypoint. If the FROM waypoint is PPOS, dashes are displayed. Wind direction is referenced to true north. The wind field is columns 17-24 and is in large font if pilot entered or actual and in small font if forecast or defaulted to.
  Wind is displayed at the T/C and T/D but not at any other pseudo waypoint.
  DIST - The enroute distance between waypoints is displayed right justified next to the via in column 9 - 12 maximum value 9999
  The distance to the TO waypoint is distance to go direct from present position. For pseudo waypoints, in the TO position, the distance is direct from the aircraft present position to the predicted LAT/LONG of the pseudo waypoint.





BM5 34 63 00 0 ASMO

F-PLN Page B
Figure 018

For the NEXT and all downpath waypoints, the distance is displayed as computed by performance. Distance is not displayed for IF, PM, VM and FM legs, and for F-PLAN markers. For these leg types the field is blank. When certain leg types are displayed in 3L - 3R, the track of that leg is displayed alongside the distance. When applicable, a preceding slash (/), a three-digit course, and a degree symbol (°) are displayed in column 13 - 17 (Ref. Fig. 018).
The applicable leg types for a track display are : CF, COND.CF, TF, COND. TF, DF, FA, FM, HA, HF, MM, PI and PM.
The track displayed is defined as follows :

TABLE 8

CF	The inbound course of the leg.
COND CF	Same as CF.
TF	The computed course from the starting fix to the terminating fix of the leg.
COND TF	Same as TF.
DF	The computed course from the previous leg's termination to the fix of the DF - when the DF is the NEXT leg, the computed course is from the end of the transitional arc of the DF to the FIX.
FA	The outbound course from the fix of the leg.
FM	Same as FA.
HA	The inbound course to the fix of the leg.
HF	Same as HA.
HM	Same as HA.
PI	The outbound course from the procedure turn fix.
PM	Same as PI.

Conditional legs and HM Legs are special cases for distance and track display. For conditional legs the distance is displayed in the label line of the leg that the FMC predicts will be flown. The track is only displayed for conditional CF and TF legs when the leg that the FMC predicts will be flown is in line 3L - 3R. For HM legs the distance is displayed in the label line of the holding fix. The track is only displayed when the holding fix is in line 3L - 3R. If the FROM waypoint is slewed into 3L - 3R, then columns 13 - 17 are blank.
A waypoint may be entered directly on the flight plan page.

2 °C and wind entries

Temperature and wind entries are used for performance predictions within the FMS. These entries are made on Flight Plan Page B, on the STEP PRED Page, or on INIT Page A. These entries can be made on a waypoint-by-waypoint basis only during the cruise phase (entry is allowed at the T/C and T/D at the origin, and at the destination). If entries are made, temperature and wind models are used to forecast all values throughout the flight plan. The displayed values of temperature and wind are a result of these models and the pilot entries. There are five ways to make wind and temperature entries.

- Directly on Flight Plan Page B - The temperature and/or wind entry is entered directly into the data field. The entry format must be

temperature/wind direction/wind velocity ; however, trailing slashes may be omitted. Leading slashes are required. If a value is left blank it is assumed to remain the same. To clear a wind or temperature entry, press the CLR key and the adjacent RLS key. The CLR removes all entries previously made at that waypoint. Entries can only be made at waypoints within the CRZ segment after the T/C and T/D have been calculated. If entry is attempted before this, message "NOT ALLOWED" is displayed.

EXAMPLE ENTRIES :

TEMP	- Enter temperature
/WIND DIRECTION/WIND MAGNITUDE	- Enter wind
TEMP/WIND DIRECTION/WIND MAGNITUDE	- Enter both temperature and wind

- On VERT REV Page B - This page contains data fields for entering both temperature and wind entries.
- On STEP PRED page - Any wind entered on the STEP PRED page will be used as the cruise wind for all waypoints at the new cruise altitude.
- On INIT Page A - The cruise temperature and wind may be entered.
- On DES FORECAST Page

**ON A/C ALL

(d)Lateral revise (LAT REV)

1 Overview

Revising an existing flight plan or stringing a new flight plan that is not prestored in the data base must be done through the flight plan lateral revise function. Any revisions made on the lateral revise pages are associated with a revise point. This revise point is the waypoint adjacent to the LLS key on the flight plan page that was pressed to give access to the LAT REV page. There are many ways to revise the flight plan through the revise function :

SID Insertion
STAR Insertion
AIRWAY insertion
VIA/GO TO insertion
Holding Pattern insertion
Procedure Turn insertion
Waypoint insertion
New destination insertion
Company Route insertion
Enable Alternate flight plan

2 LAT REV page

**ON A/C 001-005,

(Ref. Fig. 019)

**ON A/C 006-200,

(Ref. Fig. 020)

R **ON A/C ALL

Post SB 34-2064 For A/C 001-005,105-105,

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

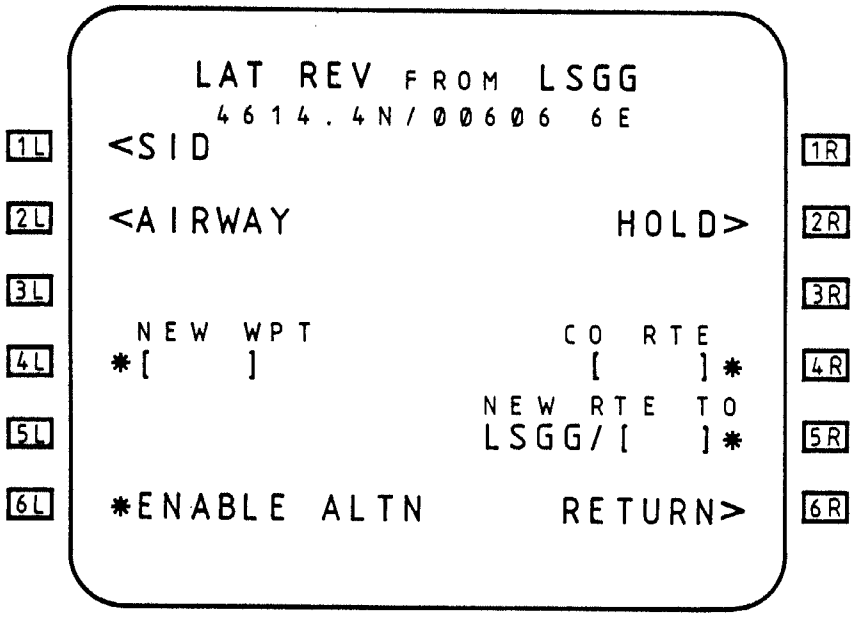
R Post SB 34-2142 For A/C 101-104,

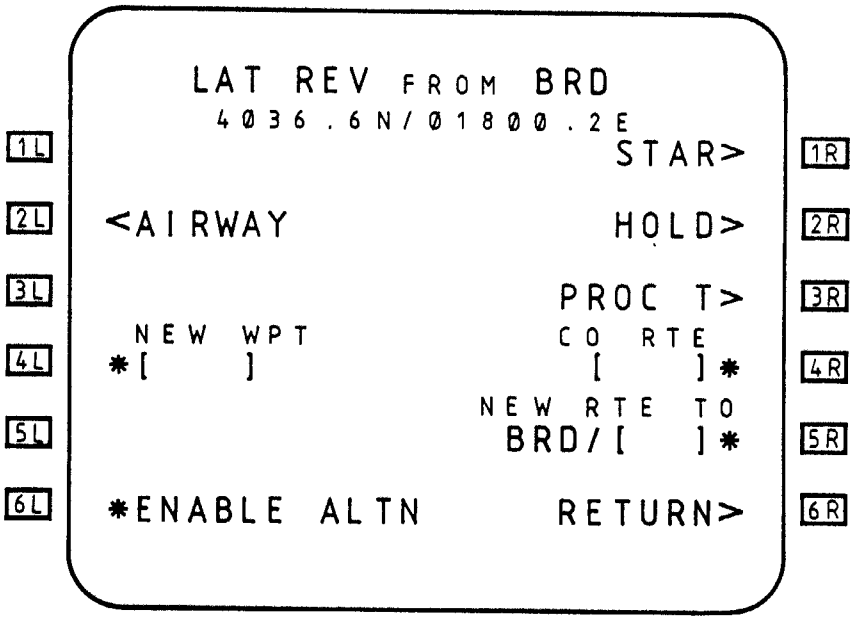
R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 021)

**ON A/C ALL

- Access - LLS key adjacent to a waypoint on either F-PLN (/SEC F-PLN) page when the scratchpad is empty. See Tables 4, 10 and 11 for access to LAT REV for each lateral waypoint, pseudo waypoint, or marker.
  Access will be allowed from the FROM waypoint. After access, if a lateral leg sequence occurs such that the revise point becomes the FROM Waypoint, then the revision is aborted and the display reverts to the F-PLN A page.
- Purpose - to revise an existing flight plan
- Data Fields
  Title - Display the selected waypoint (LSGG in the example) on the F-PLN page, left justified in column 17-22 of the title line. This waypoint is referred to as the revise point. If the LAT REV page is accessed from a F-PLN DISCONTINUITY marker then DISCON is displayed



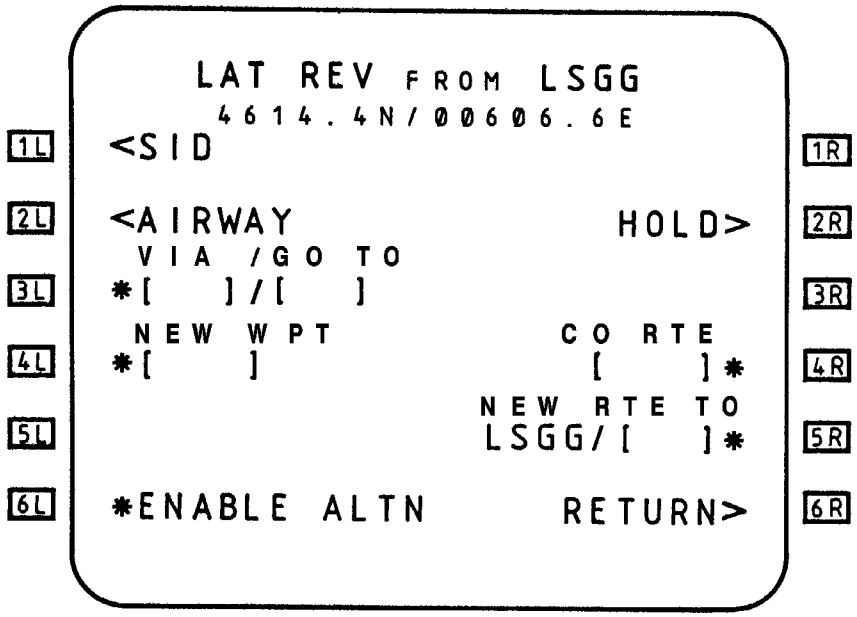


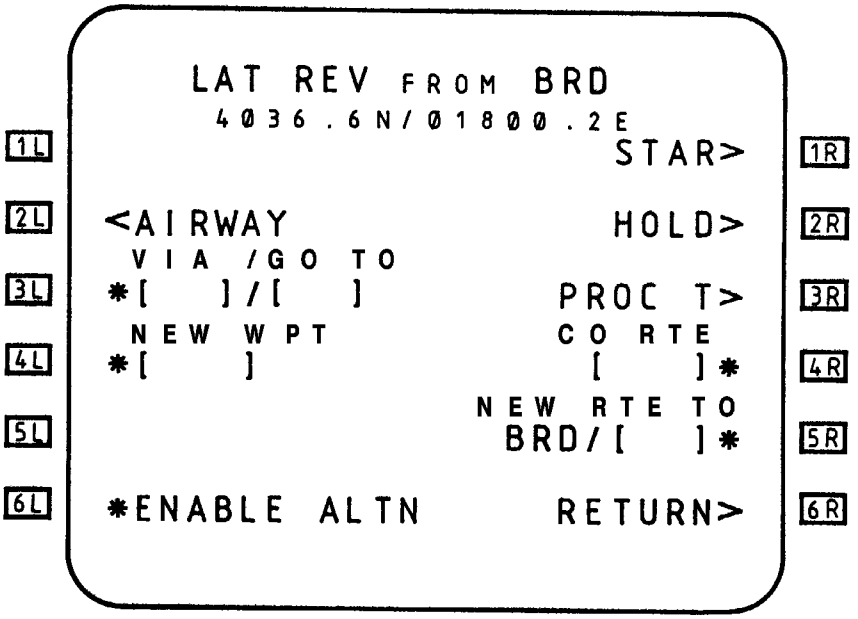
BM5 34 63 00 0 ATM0

Lateral Revise
Figure 019

R EFFECTIVITY: 001-005,

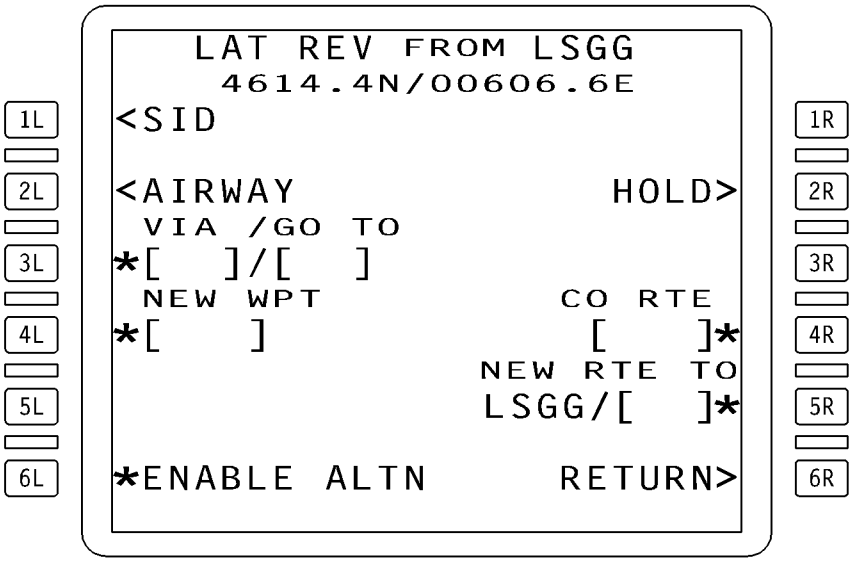
PIA

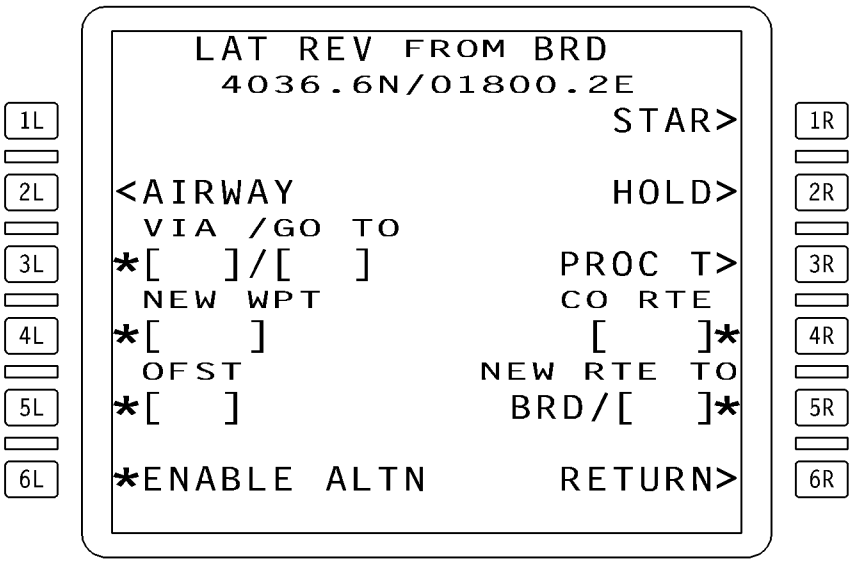




BM5 34 63 00 0 ATN0 00

Lateral Revise
Figure 020





NOTE : OFST FIELD CAN ONLY BE DISPLAYED AT FROM WAYPOINT OF PRIMARY F-PLN ON FIXED LEG TYPES.

BM5 34 63 00 0 FCM0 00

Lateral Revise
Figure 021

as the selected waypoint. The LAT/LONG of the revise point is displayed under the title line (line 2) in columns 5 - 20 if the revise point is a fixed waypoint. If the revise point was defined by PLACE/BEARING/DISTANCE, this will be displayed in column 5 - 22 instead of the LAT/LONG. If the revise point is a F-PLN DISCONTINUITY there is no LAT/LONG displayed.

1L - SID - Provides access to the SID page when LLS key is pressed. The flight phase must be PREFLIGHT there must be an origin airport defined in the flight plan and the revise point must be the origin waypoint or this prompt will not be displayed.
This prompt is not displayed if the origin waypoint is a pilot-defined runway.

2L - Airway - Provides access to the AIRWAYS page when LLS key is pressed. This prompt is displayed when the revise point is a fixed waypoint, except when this is a pilot-defined waypoint or an airport.

3L - VIA/GO TO - Inserts a portion of the airway selected (VIA) between the revise point and the airway selected waypoint (GO TO) into the flight plan and returns the display to the flight plan page.

4L- A new waypoint may be inserted into the flight plan via entry into this field. This waypoint may be a LAT/LONG, PLACE/BRG/DIST, or a waypoint identifier in the data base. To a waypoint defined by the entry of a LAT/LONG or PLACE/BRG/DIST is assigned an abbreviated identifier and becomes one of the twenty pilot-defined waypoints. When the LS key is pressed the display is changed to the flight plan page with the waypoint inserted into the flight plan.
The identifier inserted may be a waypoint, navaid, airport identifier, or runway identifier. This prompt is not displayed if the revise point is the termination of an FM, VM, PI, or PM leg.
If the revise point is the FROM waypoint, then this prompt is displayed only if it is a fixed waypoint or PPOS.

IR - STAR - Provides access to the STAR page. This prompt is available only when there is a destination airport in the flight plan, and the revise point is a fixed waypoint other than the FROM waypoint.

2R - HOLD - Provides access to the HOLD page. Prompt displayed only if revise point is a fixed waypoint (other than the termination waypoint of an HF leg), holding pattern (MANUAL of the HM leg) waypoint, or FROM waypoint.

3R - PROC T - Provides access to the PROC T page. This prompt is displayed only if the revise waypoint is a fixed waypoint or the manual termination of a PM leg, except when the revise waypoint is the FROM waypoint or the manual termination of a PM leg if that procedure turn is active.

4R - CO RTE - Solicits entry of a new company route. This prompt is displayed only for a fixed waypoint and PPOS. The display changes to the flight plan page.

**ON A/C ALL

5R - NEW RTE TO - Solicits entry of a new destination. This prompt

is not displayed if access to the **LAT REV** page was from **PPOS** or the **F-PLN DISCONTINUITY** marker. The fit waypoint listed is the revise point indicating that the new route will be from the revise point to the new destination. The display changes to the flight plan page. Entry must be either an airport stored in the **NAV DATA BASE** or a runway created by the **DEFINED WAYPOINTS** function.

6R - Return - By pressing this **LS** key the pilot may return to the **F-PLN** page last displayed without making any lateral revisions.

Any identifier entry into the **NEW WPT, CO RTE,** or **NEW RTE TO** fields must be in the data base, or the entry will be rejected and message **"NOT IN DATA BASE"** will be displayed.

3 SID

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

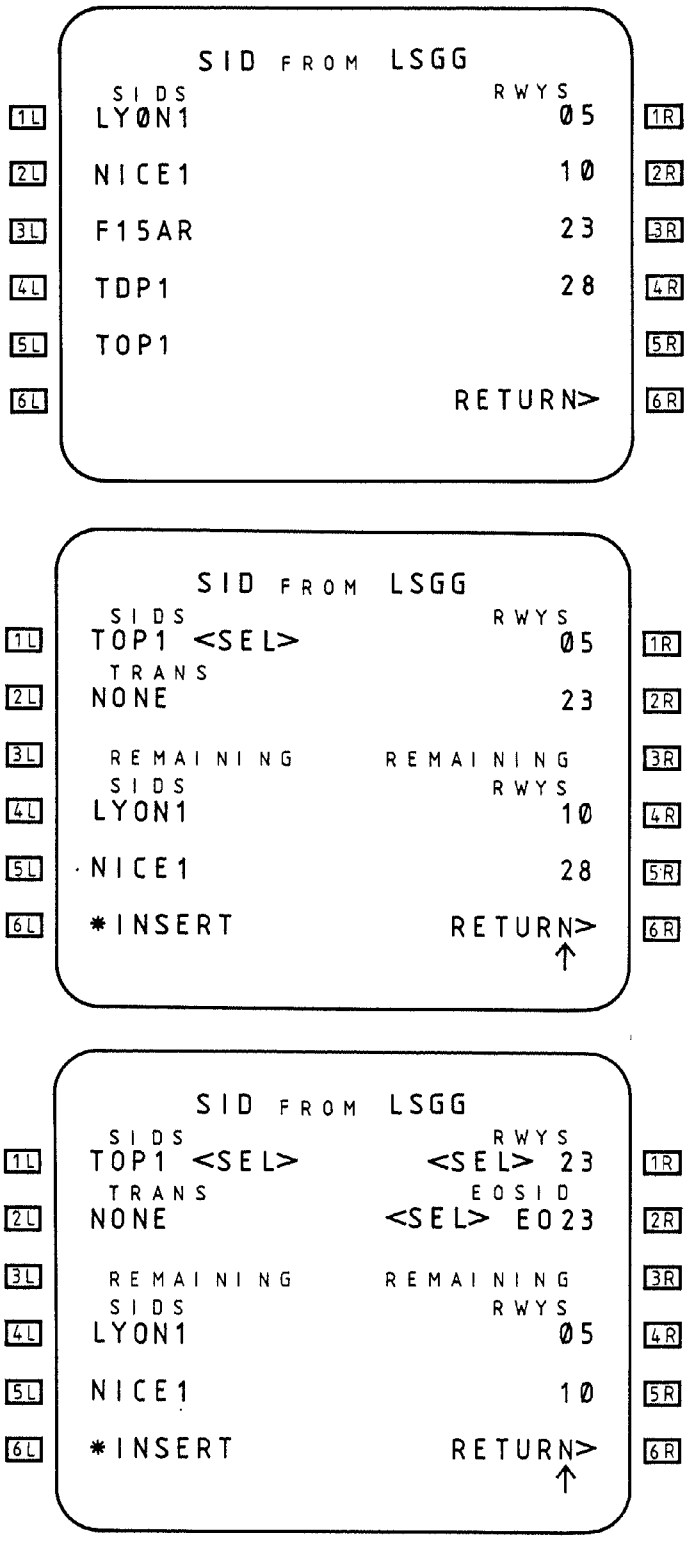
5R - OFST - A parallel offset to the active flight plan may be entered here. This field (including "OFST" on the label line) is displayed and entry allowed if the following conditions are both true :
- the revise point is the FROM waypoint of the active primary F-PLN
- the active leg is a CF, TF, FM or DF (excluding conditional CF and TF legs).
- the active leg termination waypoint is not a destination runway in the active flight plan.

If an offset has not been entered then entry brackets are displayed. The offset may be entered to the left or right of the flight plan path.
If accepted the entered offset value replaces the brackets. When an offset is cancelled the offset is no longer displayed here through the entry brackets will again be displayed if conditions above are true.
6R - ENABLE ALTN - this prompt inserts the ALTN F-PLN at the revise waypoint.

3 SID

R **ON A/C ALL

(Ref. Fig. 022)
- Access - SID LS key from LAT REV page.
- Purpose - Define a departure from the origin airport.
- Data Fields
  Title - In the title line the origin airport is listed. Only the SIDs from the origin airport are listed for selection.
  1L-5L - the SIDs available are displayed for selection. If a SID is selected it will result in the selected SID being displayed in line 1L with (SEL) displayed in columns 7-11. Also SID selection results in any enroute transitions from the selected SID being displayed in lines 2L through 5L. The remaining SIDs that are not selected are displayed after the transitions. If there are no SIDs available, NONE will be displayed in line 1L.
  1R-5R - The runways available at the origin airport are displayed for selection. If a RWY is selected it will result in the selected RWY being displayed in line 1R with (SEL) displayed in columns 13-17. Also RWY selection results in the engine out SID (if there is one) being displayed in line 2R with (SEL) displayed next to it. After the EOSID the remaining unselected runways will be displayed. If there is an EOSID for the selected runway, it will always be selected.
  2L-5L - TRANS - The enroute transitions (if there are any) from the selected SID are displayed for selection. If one is selected it will be displayed in line 2L with (SEL) being displayed in columns 7-11. Other TRANS that are not selected are displayed after the remaining SIDs. If there are no transitions, NONE will be displayed in line 2L.
  2R - EOSIDs - After a runway has been selected the EOSID for that runway (if there is one contained in the data base) will be displayed on this line and (SEL) will be displayed in columns 13-17 next to the EOSID.
  Only one EOSID per runway is contained in the data base. If there are no EOSIDs, NONE will be displayed. If the SID page was accessed from the secondary or alternate flight plan the EOSID will not be displayed for selection.
  6L - INSERT - Pressing this LS key will result in the selected departure being strung into the flight plan and the display returning to the flight plan page that was last displayed. If another mode key is pressed before INSERT is pressed, all the new selections made will be erased. INSERT is displayed if a departure has previously been inserted into the FPLN, or if a selection is made (i.e. (SEL) is displayed).
  6R - RETURN - Pressing this LS key returns the CDU display to the LAT REV page.



BM5 34 63 00 0 LEM0 00

SID
Figure 022

3.1 If a SID is selected before any runway has been selected, the runway list on the right side of the page shows those runways that are compatible with the selected SID. The incompatible runways follow in the REMAINING RWYS list.

3.2 If a SID is selected after a runway selection has been made, then the right side display does not change.

3.3 If a runway is selected before any SID has been selected the SID list on the left side of the page shows those SIDs that are compatible with the selected runway. The incompatible SIDs follow in the REMAINING SIDs list.

3.4 If a runway is selected after a SID selection has been made and the selected SID is not compatible with the newly selected runway, then the SID selection is cleared with results specified in Rule 3.7. If the selected SID is compatible with the runway, then no change is made to the left side display.

3.5 If a departure from the same origin was previously inserted and the SID page is again accessed, the SID Page will appear with the inserted departure displayed as selected.
TOP1 SID and runway 23 are displayed as selected, because on a previous access they were inserted into the flight plan.
If a runway selection was made that is no longer needed, the pilot may make a new runway selection.
An example of this : If a runway was selected and the pilot needs to select a different runway, the pilot need only press the LS key adjacent to the new runway and the selected runway will be changed.

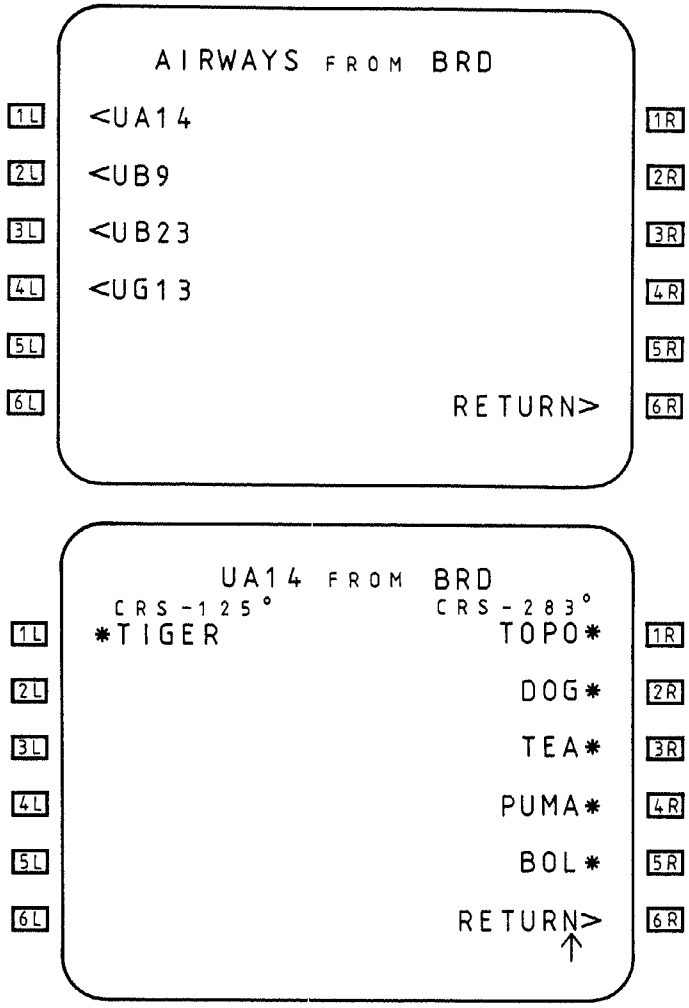
3.6 If a SID selection was made which is no longer desired then the pilot may remove the previously selected SID in the following ways :

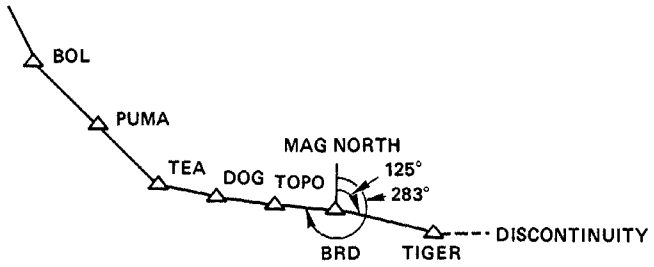
3.7 Another SID can be selected by pressing the left LS key adjacent to an alternative SID in the REMAINING SIDS list.

3.8 The SID selection can be cleared by pressing LS key 1L with CLR in the scratchpad. Any selected SID enroute transition is also cleared. If a runway was also selected then the left side of the page appears per Rule 3.3 above. If a runway was not selected, then the display appears as in figure except that INSERT may remain displayed per Rule in (6L-INSERT)

3.9 A runway can be selected which is not compatible with the selected SID. In this case, the selected SID is automatically deselected per Rule 3.4 above.

4 AIRWAYS Pages
(Ref. Fig. 023)
- **AIRWAYS PAGE :**
  Access - Airway LS key on LAT REV page.
  Purpose - select an airway leaving the revise point for flight-plan revisions.
  Data Fields
  Title - The revise point (BRD in this example) selected on the F-PLN page is displayed in columns 17 - 21, left justified.
  1L - 6L - A list of the airways in the data base that go through the revise waypoint. If there are more than six airways, vertical slewing will give access to all of the airways.
  Selecting an airway will display the waypoints contained on the airway.
  If there are no airways in the data base that go through the revise, point, then NONE is displayed in 1L in large font and 2L - 6L are blank.
  6R - RETURN - Pressing this LS key returns the display to the LAT REV page.
- **WAYPOINTS ON AIRWAY :**
  Access - LS key from AIRWAYS List page.
  Purpose - Allows flight crew to view and select an ending waypoint on an airway for insertion into the flight plan.
  Data Fields
  Title - Lists airway (UA14) that is being displayed and then revise point (Ref. Fig. 023). The revise point is in columns 17 - 21, left justified. The airway name is in columns 6 through 10, right justified.
  1L - The label line displays the course from the revise point on which the airway leaves the revise waypoint. The course is FMC calculated.
  1L-5L - Gives list of the waypoints on the airway for that course. If more than five waypoints on the airway are available, vertical slewing is used to display all the waypoints.
  1R-5R - Same as 1L-5L.
  6R - RETURN - Pressing this LS key returns the CDU display to the LAT REV page.
  Selection of a waypoint inserts that portion (between revise point and airway selected waypoint) of the airway into the flight plan and also returns the display to the flight plan page.
  The waypoint list on the airway ends when a discontinuity is encountered or the airway list ends. If the revise point is at the end of the waypoints list, then NONE is displayed in 1L or 1R as appropriate. The associated label line is blank.





AIRWAY UA14

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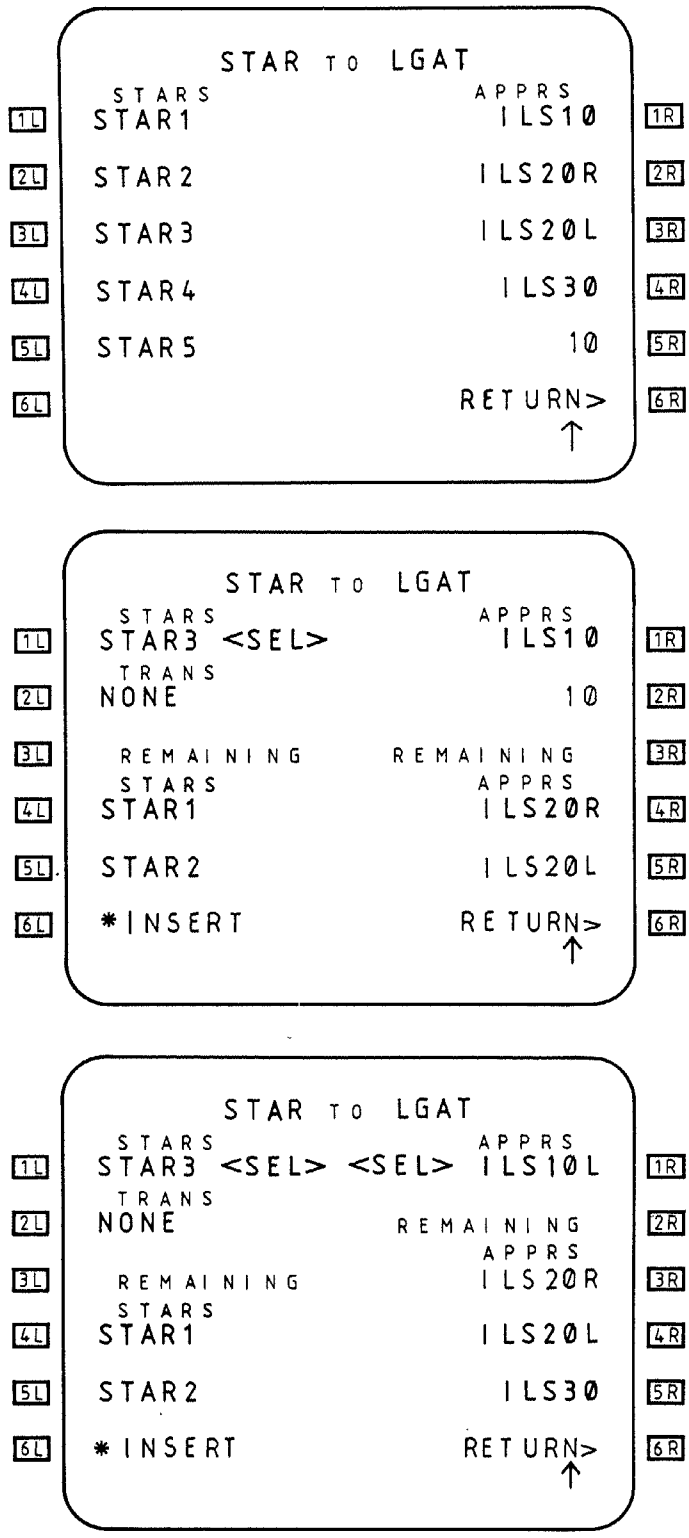
Airways
Figure 023

5 STAR pages
(Ref. Fig. 024)
- Access - STAR LS key on LAT REV page.
- Purpose - define an arrival to the destination airport.
- Data Fields
Title - The destination airport is listed in columns 15 - 18.
Only arrivals to this airport are listed for selection.
1L-5L - The STARs available are displayed for selection. If a STAR is selected it will result in the selected STAR being displayed in line 1L with (SEL) displayed in columns 7-11. Also, STAR selection results in any enroute transitions to the selected STAR being displayed after the selected STAR. The remaining STARs not selected will be displayed after the transitions.
1R-5R - The runways and approaches available at the destination airport are displayed for selection. If an approach or RWY is selected it will result in the selected approach or RWY being displayed in line 1R with (SEL) displayed in columns 13-17. The remaining runways and approaches that were not selected will be displayed following the selected one.
The approaches are displayed as :
ILS23 - for ILS approach on runway 23
RNV23 - for RNAV approach on runway 23
VOR23 - for VOR approach on runway 23
NDB23 - for NDB approach on runway 23
23 - for runway 23
The approach type is determined by the identifier in the data base. This display reflects exactly what is stored in the approach identifier in the data base.
2L-5L - TRANS - The enroute transitions (if there are any) to the selected STAR are displayed for selection. If one is selected it will be displayed in line 2L with (SEL) being displayed in columns 7-11. Unselected transitions are displayed immediately after the remaining STARs. If there are no transitions to the selected STAR, NONE will be displayed in 2L.
6R - INSERT - Pressing this LS key will result in the selected arrival being strung into the flight plan. If stringing can be completed automatically, including any required approach transition, then the display returns to the F-PLAN page that was previously displayed. If an appropriate approach transition cannot be selected automatically, then the display changes to the APP TRANS page, with the available approach transitions displayed for selection. If another mode key is pressed before INSERT is pressed, all the new selections made will be erased. This prompt will not be displayed until a new selection has been made or if an arrival has not previously been inserted into the F-PLN.
6R - RETURN - Pressing this LS key return the CDU display to the LAT REV page.

5.1 If a STAR is selected before any approach or runway has been selected, the list on the right side of the page will show approach identifiers for those approach procedures which end at runway compatible with the selected STAR. After the approach list will be displayed the



STAR Pages
Figure 024

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runway numbers for all of the compatible runways. The incompatible approaches and runways will follow in the **REMAINING APPRS** list.
(Ref. Fig. 024)

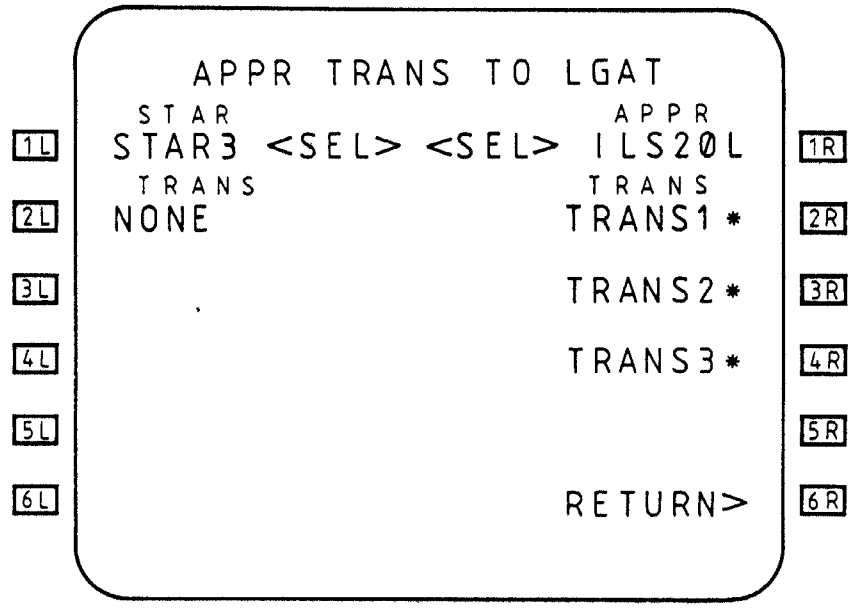
5.2 If a **STAR** is selected after an approach or runway selection has been made, then the right side display does not change.

5.3 If an approach or runway is selected before any **STAR** has been selected the list on the left side of the **STAR** page will show those **STARs** that are compatible with the runway selected or implied by the approach selection. The incompatible **STARs** will follow in the **REMAINING STARS** list.

5.4 If an approach or runway is selected after a **STAR** selection has been made and the previously selected **STAR** is not compatible with the newly selected approach or runway, then the **STAR** selection is cleared with the results specified in Rule 5.2 above. If the previous selected **STAR** is compatible then the left side display does not change.
If an arrival to the same destination was previously inserted and the **STAR** page is accessed again, the display would appear with the same configuration that was previously inserted.
If an approach or runway selection has been made that is no longer needed, the pilot may make a new selection.

5.5 If a **STAR** selection was made which is no longer desired, then the pilot may remove the selection in the following ways :
- Another **STAR** can be selected by pressing the left **LS** key adjacent to an alternative **STAR** in the **REMAINING STARS** list.
- The **STAR** selection can be cleared by pressing **LS** key 1L with **CLR** in the scratchpad. Any selected **STAR** enroute transition is also cleared.
If an approach or runway was also selected, then the left side of the page appears per rule 5.3 above.
If no approach or runway was selected, then the display appears as in figure (Ref. Fig. 024) except that **INSERT** may remain displayed per Rule in (6L-**INSERT**).
- An approach or runway can be selected which is not compatible with the selected **STAR**. In this case, the selected **STAR** is automatically deselected per Rule 5.4 above.

6 **APPR TRANS** Page
(Ref. Fig. 025)
- Access - **INSERT LS** key on **STAR** page if approach transition cannot be automatically selected.
- Purpose - Define an approach transition for inserted arrival.
- Data fields.
  Title - the destination airport is listed in column 18 - 21.
  1L - **STAR** - The inserted **STAR** is displayed with (SEL) along side it. If no **STAR** has been inserted then **NONE** is displayed.
  2L - **TRANS** - The inserted enroute transition is displayed with (SEL) alongside it. If no enroute transition has been inserted, then **NONE** is displayed.
  1R - **APPR** - The inserted approach is displayed with (SEL) alongside.
  2R - 5R - **TRANS** - The approach transitions for the inserted approach are displayed for selection (Ref. Fig. 025). Pressing the **LS** key alongside an approach transition inserts that transition into the flight plan. The display returns to the **F-PLAN** page that was



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APPR. TRANS Page
Figure 025

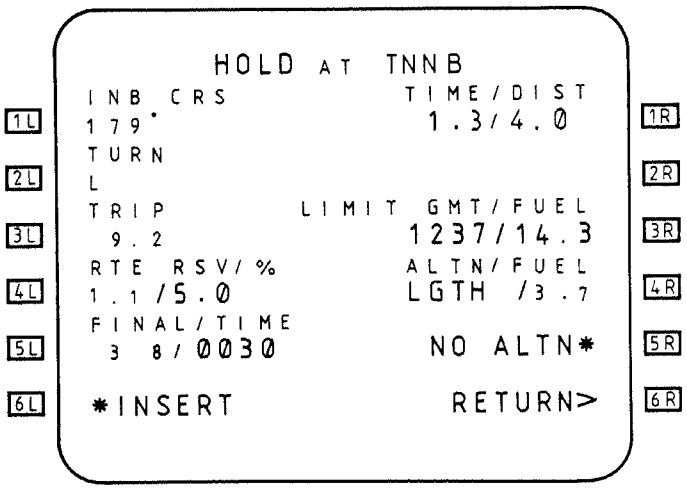
previously displayed.
6R - RETURN - Pressing this LS key returns the display to the **F-PLN** page displayed with the **STAR-APPROACH** Strung.
Format rules for **<SEL>** prompts are identical to the **SID** page.

7 HOLD page
(Ref. Fig. 026)
- Access - HOLD LS key on LAT REV page.
- If the HOLD page is displayed and aircraft position becomes invalid, then the display returns to the previous F-PLAN page and message "A/C POSITION INVALID" is displayed in the scratchpad.
- Purpose - Allows flight crew to insert or modify holding pattern in the flight plan.
- Data fields
The following figure (Ref. Fig. 027) shows how the title, the prompt in 2R and the HM Parameters in lines 1L, 2L, and 1R are all a function of the revise point selected on the F-PLN page.
- Title : Depending on the revise point selected (see flow chart in (Ref. Fig. 027), the following titles can be displayed :
- a1 HOLD AT - This is displayed in columns 7-13.
- a2 DATABASE HOLD AT or COMPUTED HOLD AT is displayed in columns 2-17 according to the defining rules in the Flow Chart of (Ref. Fig. 027)
- a3 The revise point selected on the F-PLN page is displayed left justified in columns 19-23, if the title is DATABASE HOLD AT or COMPUTED HOLD AT. If the title is HOLD AT, the revise point is displayed left justified in columns 15-19.
If the revise point is PPOS (per rules of (Ref. Fig. 027), then PPOS is displayed left justified per the rules of revise waypoint display.
- Prompt in line 2R : The logic which determines when a prompt will appear in 2R and the type of prompt, when the HOLD page is first accessed, is given in the flow chart of (Ref. Fig. 027).
The following may appear in line 2R :
- b1 DATABASE : displayed in columns 17-24 in large font
- b2 COMPUTED : displayed in columns 17-24 in large font
- b3 Blank
In the cases where DATABASE or COMPUTED is displayed in 2R, REVERT TO is displayed in small font on the label line in columns 16-24.
The flow charts in the following figures (Ref. Fig. 028, 029) describe how the prompt in 2R and the page title are interrelated, following pilot alterations of any of the hold parameters in 1L, 2L and 1R, for the different types of HOLD page. In each case the hold parameters may be altered by pilot entry.
- Key to Flow Chart (Ref. Fig. 027)

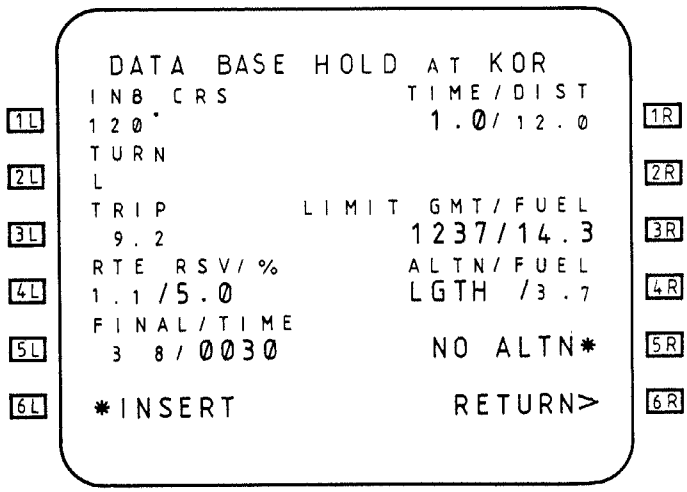
No.	DECISION BOX	LOGIC
1	Is the revise point the termination of an HM leg or the termination of a leg prior to an HM leg ?	
2	Has this hold been inserted as part of a procedure ?	
3	Is the existing HM a COMPUTED HOLD at PPOS ?	
4	Is the revise point the FROM waypoint ?	

No.	DECISION BOX	LOGIC
5	Is there a holding Pattern stored for this revise point in the Enroute Holding Pattern File ?	
6	Have any of the Hold File Parameters displayed in 1L, 2L or 1R been modified by pilot entry in the existing HM ? (i.e are they different from in the Enroute Holding Pattern File ?)	
7	Have any of the default parameters displayed in 1L, 2L or 1R been modified by pilot entry in the existing HM ? (i.e are they different from the default parameters ?)	

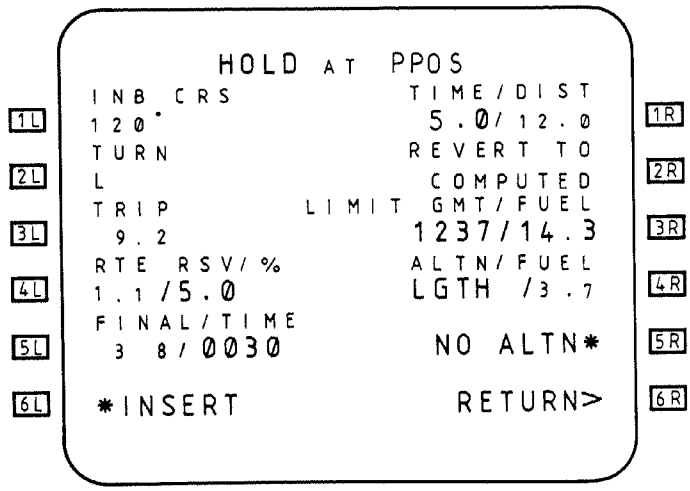
A) REVISE POINT IS EXISTING HOLD, PART OF A PROCEDURE .



B) HOLD PAGE WITH NAV DATA BASE PARAMETERS.UNCHANGED BY PILOT ENTRY.



C) PAGE WITH SYSTEM COMPUTED PARAMETERS : CHANGED BY PILOT ENTRY.



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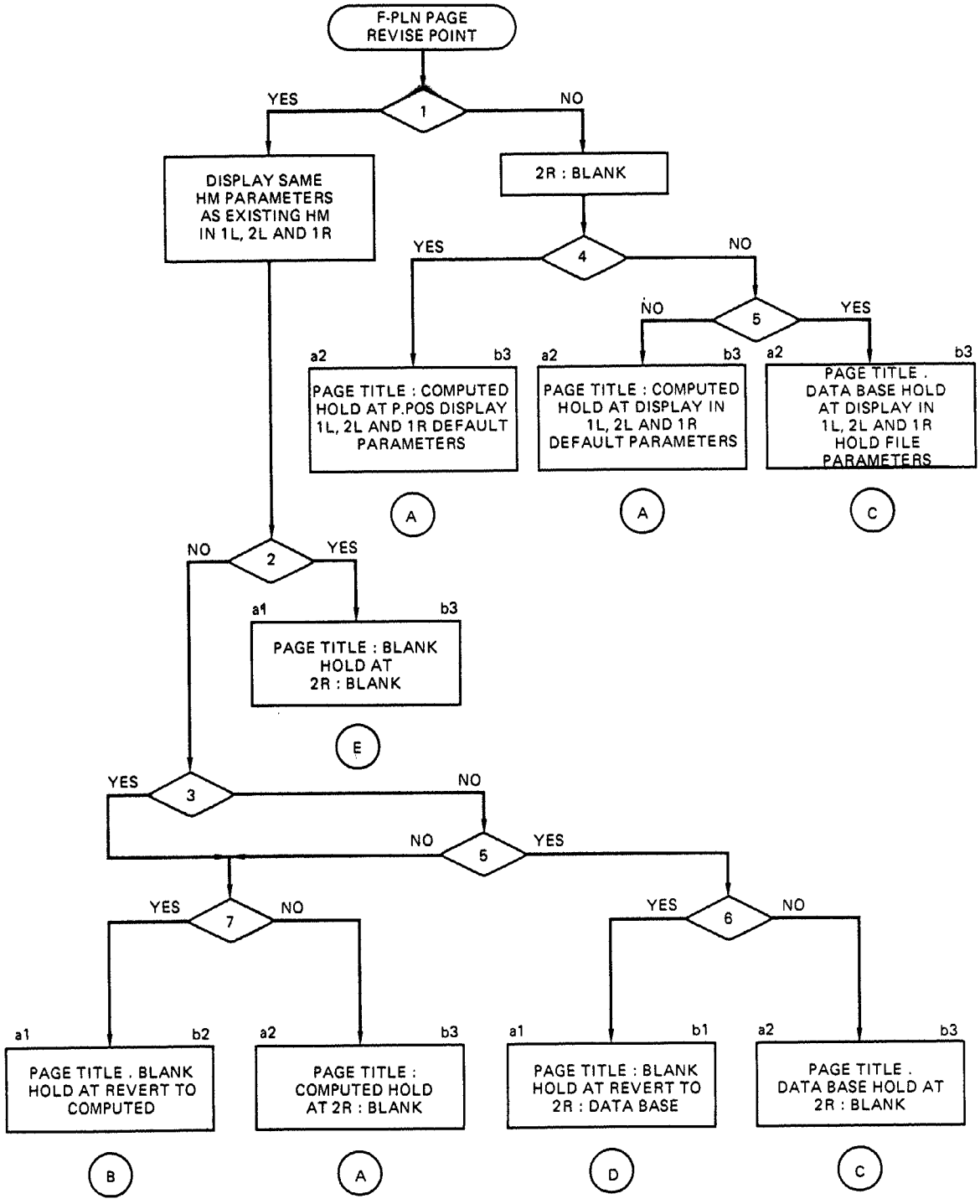
Hold Page
Figure 026



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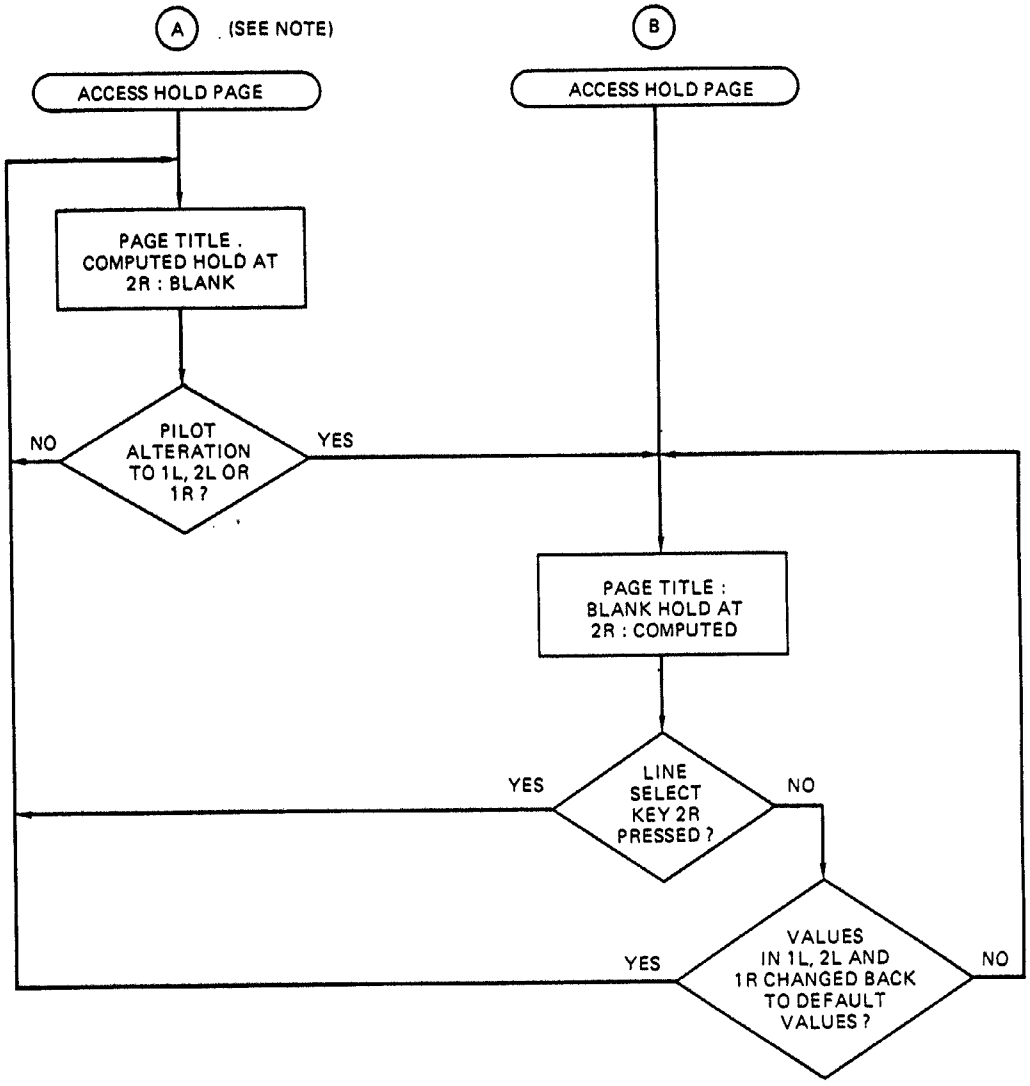
Hold Page Display Rules
(Upon First Accessing HOLD Page)
Figure 027



NOTE : A THROUGH E ON FLOW CHARTS
B AND C ARE CONTINUATION POINTS.

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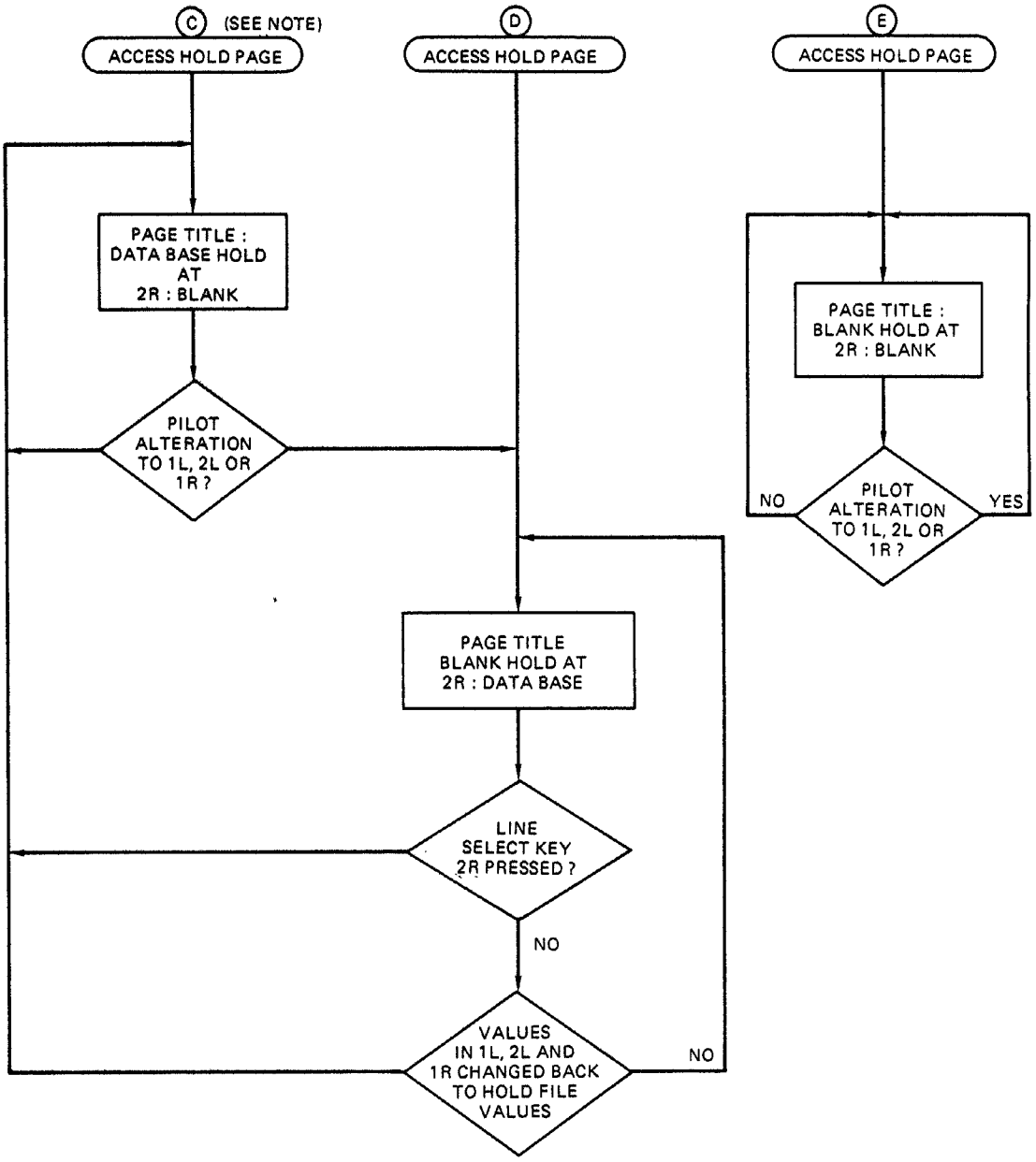
Display Logic for Title Versus Prompt in 2R for COMPUTED HOLD
Figure 028


C (SEE NOTE)
ACCESS HOLD PAGE
D
ACCESS HOLD PAGE
E
ACCESS HOLD PAGE
PAGE TITLE : DATA BASE HOLD AT 2R : BLANK
PILOT ALTERATION TO 1L, 2L OR 1R ?
PAGE TITLE : BLANK HOLD AT 2R : BLANK
NO
PILOT ALTERATION TO 1L, 2L OR 1R ?
YES
PAGE TITLE BLANK HOLD AT 2R : DATA BASE
LINE SELECT KEY 2R PRESSED ?
NO
VALUES IN 1L, 2L AND 1R CHANGED BACK TO HOLD FILE VALUES
NO

NOTE . A THROUGH E ON FLOW CHARTS B AND C ARE CONTINUATION POINTS.

BM5 34 63 00 0 AYG0

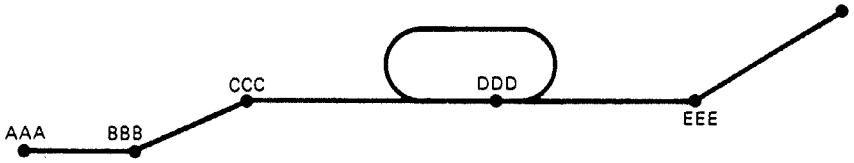
Display Logic for Title Versus Prompt in 2R for DATABASE Hold and Holds from a Procedure
Figure 029

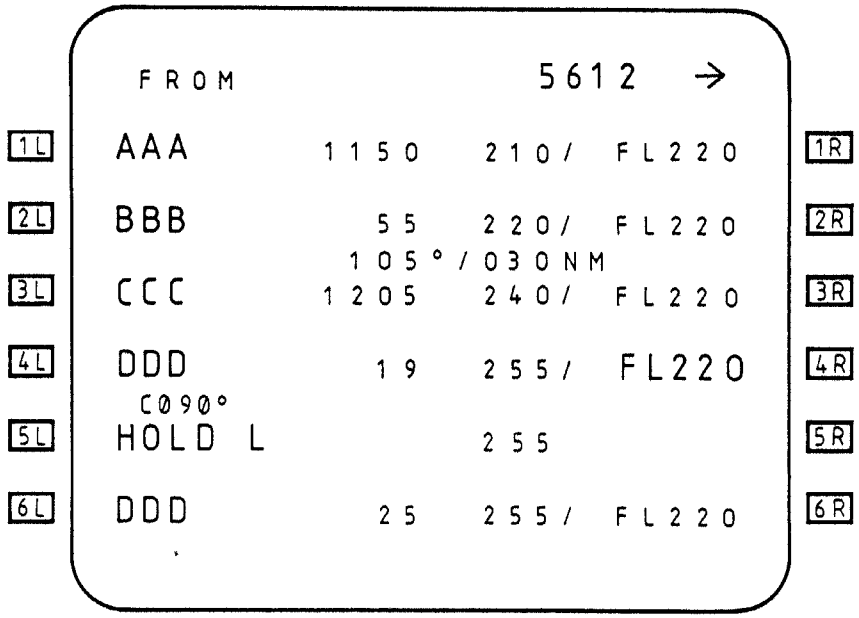
1L - **INB CRS** - The flight crew can specify inbound course. Default is course to holding fix from preceding waypoint. If the revise point is the **FROM** waypoint (meaning the hold is at present position), the present track will be the default value. Also, if there is no inbound course into the revise point (following a discontinuity) the present track will be the default value. If a value cannot be displayed because present track is invalid then dashes are displayed but entry is allowed.
2L - Turn direction - The flight crew may select a right or left holding pattern by entering **R** or L respectively via the scratchpad. The default turn direction is right.
3L - **TRIP** - The calculated trip fuel from the holding fix to the destination is displayed here using the display rules defined for **INIT** page **B**.
4L - **RTE RSV/%** - The route reserves expressed in weight and percentage of trip fuel. The display and entry rules are as defined for the **INIT** page **B**.
5L - **FINAL/TIME** - The calculated hold fuel/time. The display and entry rules are as defined for the **INIT** page **B**.
6L - **INSERT** - Inserts holding pattern into flight plan and returns the display to the **F-PLN** page that was last displayed. This prompt is displayed only when 1L, 2L and 1R are complete and the hold is not an existing **HM** in the flight plan at the selected revise point. If the revise point is an **HM** already in the flight plan, an alteration by pilot entry to 1L, 2L, 1R or selection of the prompt in 2R (if displayed) is required before the **INSERT** prompt is displayed. If the holding pattern is at present position, the holding fix is the **LAT/LONG** of the **A/C** when the **INSERT** LS key is pressed. Prior to insertion of the hold any pilot entry in 1L, 2L or 1R may be cleared. If a new **HM** leg is being defined, then the field reverts to :
- the default value if the hold is a **COMPUTED HOLD**.
- the value obtained from the Enroute Holding Pattern File if the hold is a **DATABASE HOLD**.

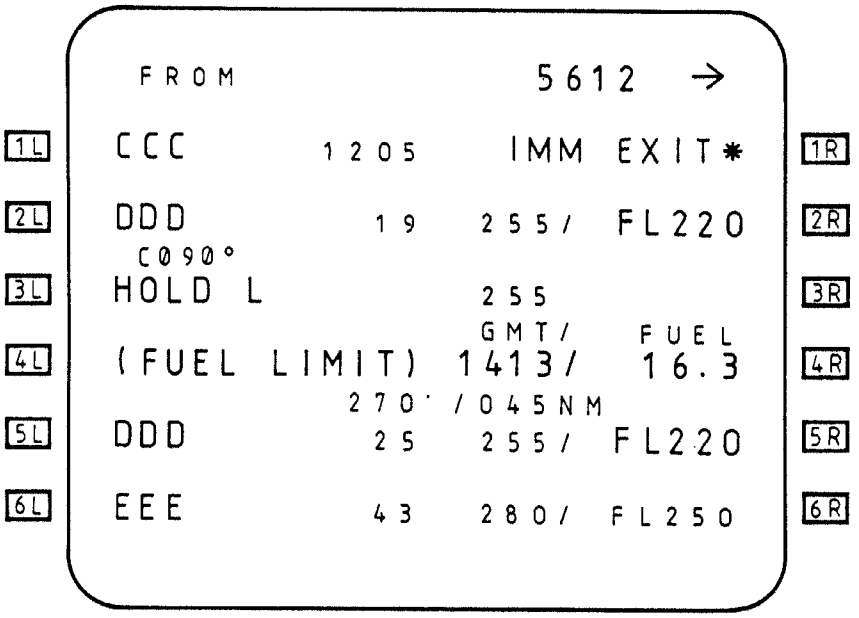
If an existing **HM** leg is being modified, then the field reverts to :
- the default value if the existing hold is a **COMPUTED HOLD** (Ref. Fig. 027)
- the value obtained from the Enroute Holding Pattern File if the existing hold was originally a **DATABASE HOLD**.
  (State D on the flow chart of figure (Ref. Fig. 027)
- the value which was displayed in the field upon accessing the hold page, if the existing hold was inserted as part of a Procedure. If a mode key is pressed prior to pressing **INSERT** any newly entered data is erased.

1R - **TIME/DISTANCE** - The time (in minutes) and distance of a leg for the holding pattern. The default value is 1.0 minute below 14,000 feet or 1.5 minutes above 14,000 feet. The altitude used to determine this is the predicted altitude at the revise point when the **HOLD** page was accessed. If **PPOS** is the revise point, the default time is assumed to be at the aircraft altitude when the **HOLD** page was accessed. The pilot may change this value via the scratchpad.

In both cases, time is the leg defining parameter and the distance is calculated accordingly. Instead of entering a time, the pilot may enter a distance. In this case, distance becomes the leg defining parameter and the time is calculated accordingly.
A DIST entry must be preceded by a slash (**/**). The pilot is not allowed to enter **TIME** and **DIST** simultaneously **;** any such entry will be rejected and message **"NOT ALLOWED"** will be displayed.
The parameter (**TIME** or **DIST**) that defines the hold leg will be displayed in large font. The calculated value will be displayed in small font. If the pilot enters a value it becomes the defining parameter and will be displayed in large font.
3R - LIMIT - GMT/FUEL. The time by which the holding pattern must be exited, and the fuel available for the hold such that reserve requirements are met. These are calculated values, and pilot entry is not allowed. Because it is a limit value, this data is always displayed in large font. If a value is not available, then dashes are displayed.
4R - ALTN/FUEL - . The **ALTN** destination is displayed right justified in columns 15 - 19 in large font. Any flight plan revisions that affect the alternate destination will be reflected in this field. If no alternate destination exists, then **NONE** is displayed. The **ALTN** fuel is displayed right justified in columns 21 - 24. If this is a calculated value, then it is displayed in small font. If it has been entered, either here or on the **INIT** page **B**, then it is displayed in large font.
If the pilot-entered value is cleared (using **CLR** key), then this field reverts to the calculated value. An **ALTN** destination cannot be defined by entry into this field. Any attempt to do so will cause message 15 to be displayed.
5R - NO ALTN - . This prompt is only displayed if an **ALTN** destination exists. Pressing this **LS** key when this prompt is displayed deletes the alternate destination and alternate route legs, and thereby sets the **ALTN** fuel to zero.
6R - RETURN - . Pressing this **LS** key returns the **CDU** display to the **LAT REV** page. If the **RETURN** prompt **LS** key is pressed prior to **INSERT**, all newly entered data are erased.
N. F-PNL after insertion of HOLD
The following description shows different **F-PLN** pages **A** dependent on different situations which might appear when a **HOLD** was inserted into the **F-PLN.**
The mechanization is the same for **F-PLN** page **B.**
SCENARIO 1
Assume the **F-PLN** with legs **AAA** to **BBB, BBB** to **CCC, CCC** to **DDD** and **DDD** to **EEE.**
1a assumption : insertion of a Hold at **DDD** (via **LAT REV** at **DDD**)
The **F-PLN** will display **AAA** as from **WPT**
(Ref. Fig. 030)
Line **4R** displays the hold speed and predicted altitude at the entry of the hold. It is defined as :
- max endurance (small font) limited by **ICAO** speed (large font). Clear function is available if the speed is limited by **ICAO.**







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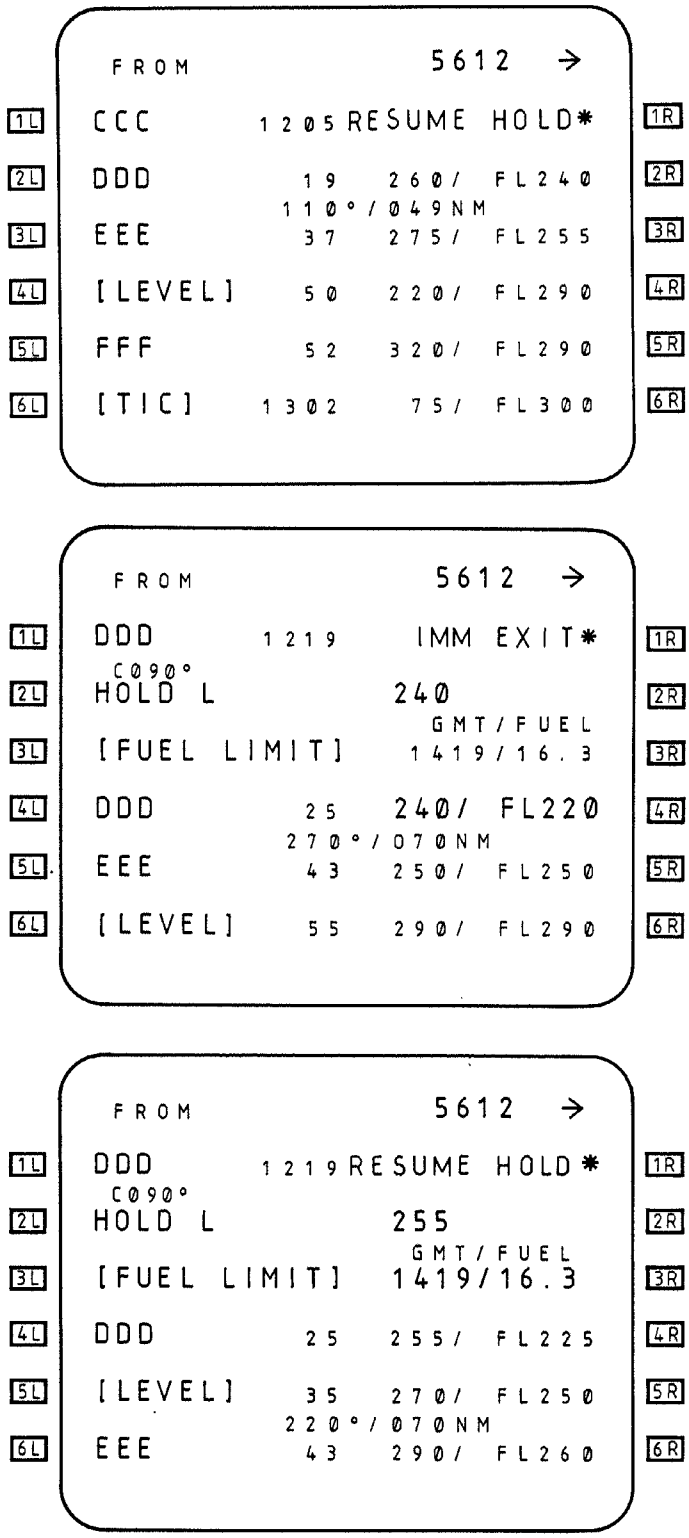
F-PLN After Hold Insertion Sheet 1 of 3
Figure 030

The predicted time for the downpath waypoints from the hold fix is the predicted time based on a single pattern.
The speed for the downpath waypoints from EEE is the predicted speed for the actual mode (e.g ECON)
When a hold is inserted all downstream time constraints from holding fix are deleted.
Pressing CLR on CDU and line select key 4L or 6L deletes the holding from the F-PLN.
Pressing line select key 4L or 6L gives access to LAT REV.
Pressing line select key 4R or 6R gives access to VERT REV.
1b given condition 1a and assumption 2 (Ref. Fig. 030) (Part B) that the aircraft commences the hold maneuver but has not yet crossed WPT DDD for the first time (the hold maneuver is considered to commence at the beginning of the deceleration : 3 minutes before the aircraft passes WPT DDD)
1C given condition 1b and the assumption 3 (Ref. Fig. 031) (Part A) that the IMM EXIT prompt 1R is selected
1d given condition 1b and the assumption 4 (Ref. Fig. 031) (Part B) that the aircraft has passed DDD and is in the holding. Entry of speed via scratchpad is possible in line 2R. The speed displayed becomes large font and clear function is available. The altitude displayed for the hold is the altitude at the next crossing of the hold fix.
1e given condition 1d and the assumption 5 (Ref. Fig. 031) (Part c) that the IMM EXIT prompt is selected.
SCENARIO 2
Assume the F-PLN with legs AAA to BBB and BBB to CCC with AAA as the FROM WPT and that the HOLD at PPOS is inserted
(Ref. Fig. 032)


FROM 5612 →
1L CCC 1205 RESUME HOLD* 1R
2L DDD 19 260/ FL240 2R
110°/049NM
3L EEE 37 275/ FL255 3R
4L [LEVEL] 50 220/ FL290 4R
5L FFF 52 320/ FL290 5R
6L [TIC] 1302 75/ FL300 6R
FROM 5612 →
1L DDD 1219 IMM EXIT* 1R
C090°
2L HOLD L 240 2R
GMT/FUEL
3L [FUEL LIMIT] 1419/16.3 3R
4L DDD 25 240/ FL220 4R
270°/070NM
5L EEE 43 250/ FL250 5R
6L [LEVEL] 55 290/ FL290 6R
FROM 5612 →
1L DDD 1219 RESUME HOLD* 1R
C090°
2L HOLD L 255 2R
GMT/FUEL
3L [FUEL LIMIT] 1419/16.3 3R
4L DDD 25 255/ FL225 4R
5L [LEVEL] 35 270/ FL250 5R
220°/070NM
6L EEE 43 290/ FL260 6R

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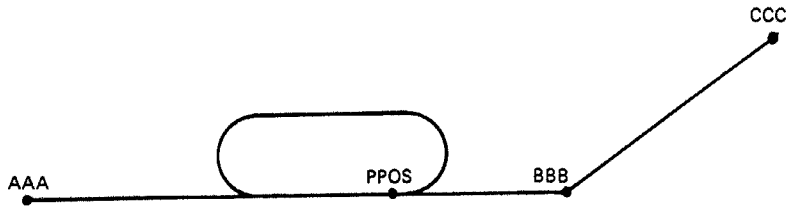
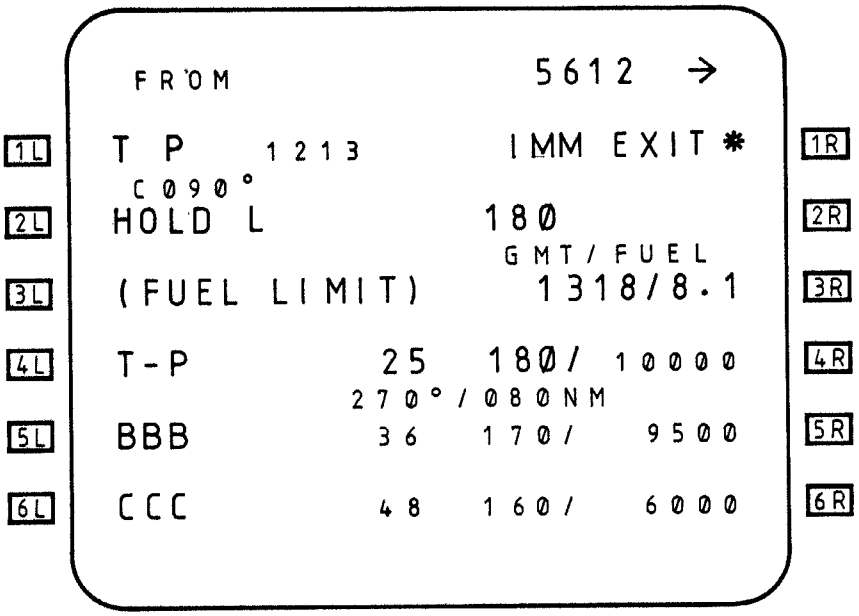
F-PLN after Hold Insertion Sheet 2 of 3
Figure 031



THE F.PLN A PAGE WILL APPEAR AS FOLLOWS :



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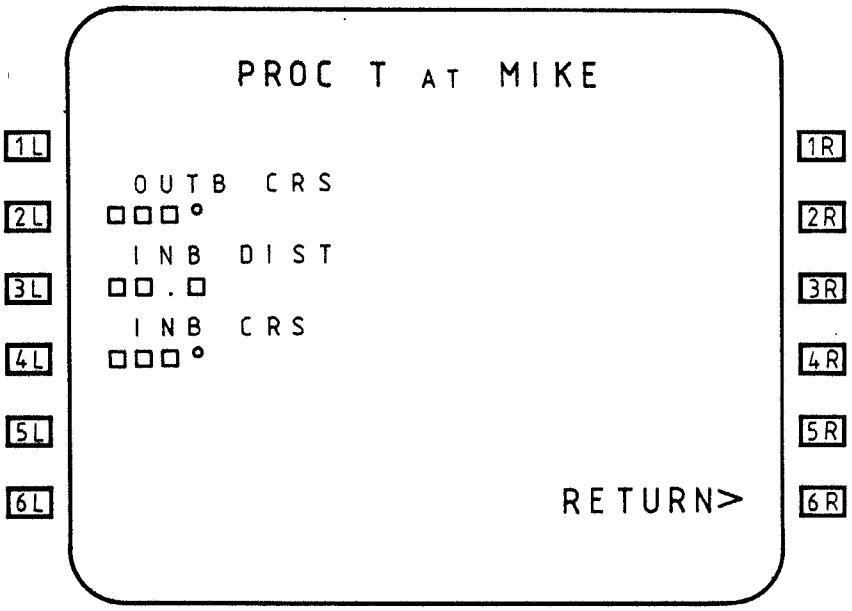
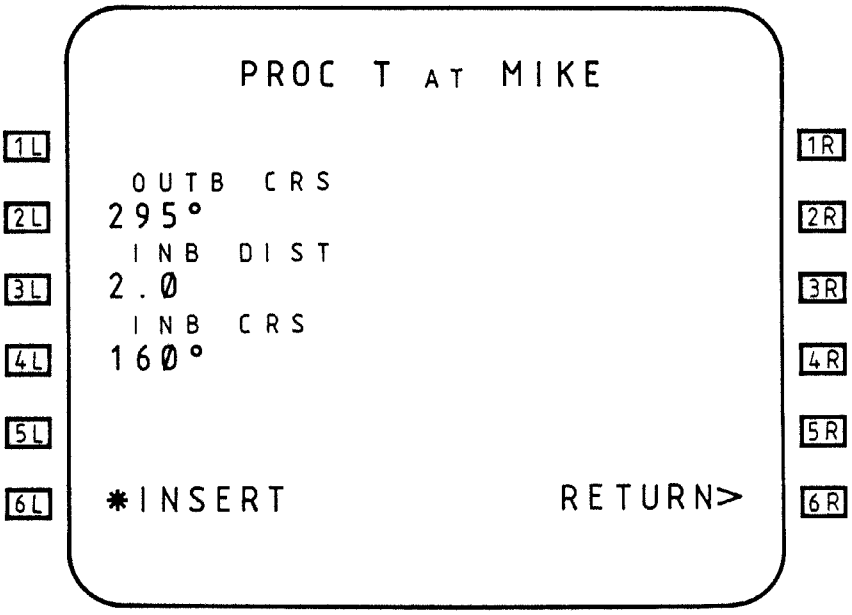
F-PLN after Hold Insertion Sheet 3 of 3
Figure 032

8 PROC TURN page (Ref. Fig. 033)
- Access - PROC T LS key on LAT REV page
- Purpose - Allows flight crew to insert or modify procedure turn to a manual termination in flight plan at the revise waypoint.
- Data Fields

Title - Revise point at which procedure turn will be inserted. (MIKE in example). The revise point is displayed in columns 15 - 19, left justified.
2L - OUTB CRS - course to leave revise point.
3L - INB DIST - length of inbound leg to revise point.
4L - INB CRS - inbound course to revise point.
6L - INSERT - Inserts procedure turn into flight plan. This prompt is displayed when lines 3L, 3L, and 4L are all complete. Returns display to the F-PLN page. If a mode key is pressed prior to pressing INSERT, the newly defined data will be erased.
6R - RETURN - Pressing this LS key returns the CDU display to the LAT REV page.
The type of procedure turn entered is a procedure turn to a manual termination.
If a PM leg already exists at the revise point, the defining parame-te will be displayed in lines 2L, 3L, and 4L. If these parameters are changed and INSERT is pressed, the PROC T will be modified to the new parameters. The old PROC T will be deleted.
When the INSERT LS key is pressed, the parameters input by the pilot must be checked to ensure the aircraft can fly the procedure turn. The following criteria must be met (Ref. Fig. 034) or the PM will not be accepted and message "ENTRY OUT OF RANGE" will be displayed :

$$\text{alpha} \leq 90^{\circ}$$





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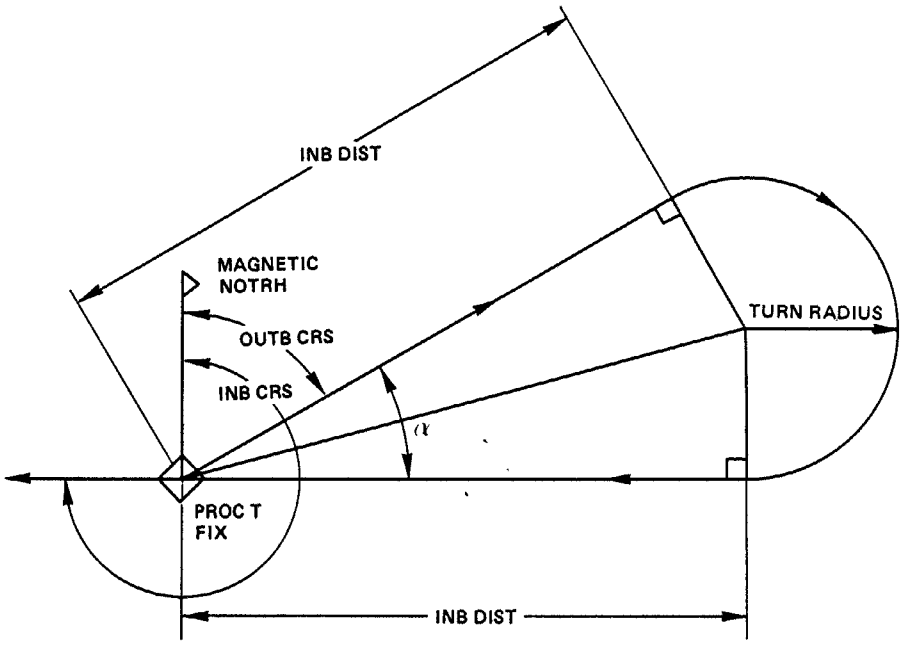
Procedure Turn
Figure 033



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DM5

Procedure Turn with Manual Termination
Figure 034

(e)Vertical revise (VERT REV)

1 Overview.

The vertical revise function allows the flight crew to revise the flight plan in ways that affect the vertical profile. Access to this function is through the RLS keys of F-PLN pages. There are two vertical revise pages, one for F-PLN Page A (VERT REV A) and one for F-PLN Page B (VERT REV B).

There are three things available through both of the VERT REV pages.

- The flight crew may change the speed limit.
- Access to the STEP PRED page is obtained.
- The predicted fuel on board and EXTRA fuel at the revise waypoint is displayed if the revise point is a waypoint. The principles of the computation are explained in chapter (12) (PROGRESS and FUEL Page)

Through VERT REV page A the pilot may insert speed, altitude and time constraints. Also, the ALONG TK OFST page may be accessed.

Through VERT REV page B the pilot may enter temperature and wind at a waypoint.

2 VERT REV Page A. (Ref. Fig. 035)

- Access - RLS key on F-PLN Page A or SEC F-PLN Page A with scratchpad empty. Access will be allowed as specified in Tables 4, 10 and 11.
- Access is allowed from the FROM waypoint. After access, if a lateral leg sequence occurs such that the revise point becomes the FROM waypoint, then the revision is aborted and the display reverts to the F-PLN page A.

  N/P key from VERT REV Page B. The same revise point is assumed.
- Purpose - Allows the flight crew to enter or modify vertical changes into the flight plan. The changes are inserted into the flight plan that allowed access to this page.
- Data Fields

  Title - (line 2) Displays the predicted fuel remaining at the revise point in columns 14-18, rounded to the nearest .05 increment.

  The fuel is displayed only if the revise point is a lateral waypoint. The fuel is not displayed if the revise point is the manual termination of an HM, VM, FM or PM leg.

IL - CLEAR SPD - Pressing this LS key will clear the speed constraint at the revise point and return the display to the last displayed F-PLN page. This prompt is only displayed when there is a speed constraint at the revise point.

2L - SPD - Entry of speed into this line will create a speed constraint at the revise point and also return the display to the last displayed F-PLN page. If the revise point is T/C, T/D, or SPD LIM, this prompt will not be displayed.

3L-5L - Entry of an altitude or flight level into any of these lines will create an altitude constraint at the revise point. Depending upon the line on which the entry is made, an AT, AT or ABOVE, or AT or BELOW constraint is created. Also, entering the constraint will return the display to the last displayed F-PLN page. This prompt is not displayed if the revise waypoint

is a VA, HA, or FA leg. If an ALT or SPD constraint is entered into 2L, 3L, 4L, or 5L with the revise point at a CRZ waypoint (between T/C and T/D) or at any waypoint before the T/C and T/D are calculated, a *CLB OR DES* prompt will be displayed in line 6L-6R. The pilot must choose CLB or DES by pressing the appropriate LS key before the FMC can accept the constraint into the flight plan. Choosing CLB or DES inserts the constraint and changes line 6L-6R to redisplay what was there before the constraint entry. (Ref. Fig. 035). If VERT REV Page A is exited before choosing CLB or DES, the prompt will no longer be displayed or the new page and the constraint will not be accepted.

6L - CLEAR ALT - Pressing this LS key will clear the altitude constraint at the revise point and return the display to the last displayed F-PLN page. This prompt is only displayed if there is an altitude constraint at the revise point.

1R - CLEAR TIME - Pressing this LS key will clear the time constraint at the revise point and return the display to the last displayed F-PLN page. This prompt is only displayed if there is a time constraint at the revise point.

2R - TIME - Entry of a time into this line will create a time constraint at the revise point and also return the display to the last displayed F-PLN page. This prompt is displayed only if the revise point is a fixed waypoint.

SPD LIM - The speed limit is displayed here and can be changed by the pilot. If the revise point is prior to or at the T/C, the displayed speed limit is the CLB speed limit; otherwise, the DES speed limit is displayed. If the aircraft is in the DONE, PRE-FLIGHT, TAKEOFF, or CLB flight phase and there is no T/C in the flight plan, this field will be dashes. If the aircraft is in the CRZ, DES, or APPR flight phase, the speed limit is the DES speed limit.

The speed limit must be entered as SPD/ALT. If the speed limit is the default value (250/10000) it will be displayed in small font. Pilot entered speed limit will be displayed in large font. Clearing this field causes the speed limit to revert to the default value. This field is dashes if the speed limit pseudo waypoint has been cleared (using the left LS key) on either F-PLN page.

ALONG TRK OFST - Allows access to the along track offset page. This prompt is displayed only if the revise point is a fixed waypoint other than the FROM waypoint within the primary portion of the ACTIVE or SEC F-PLN.

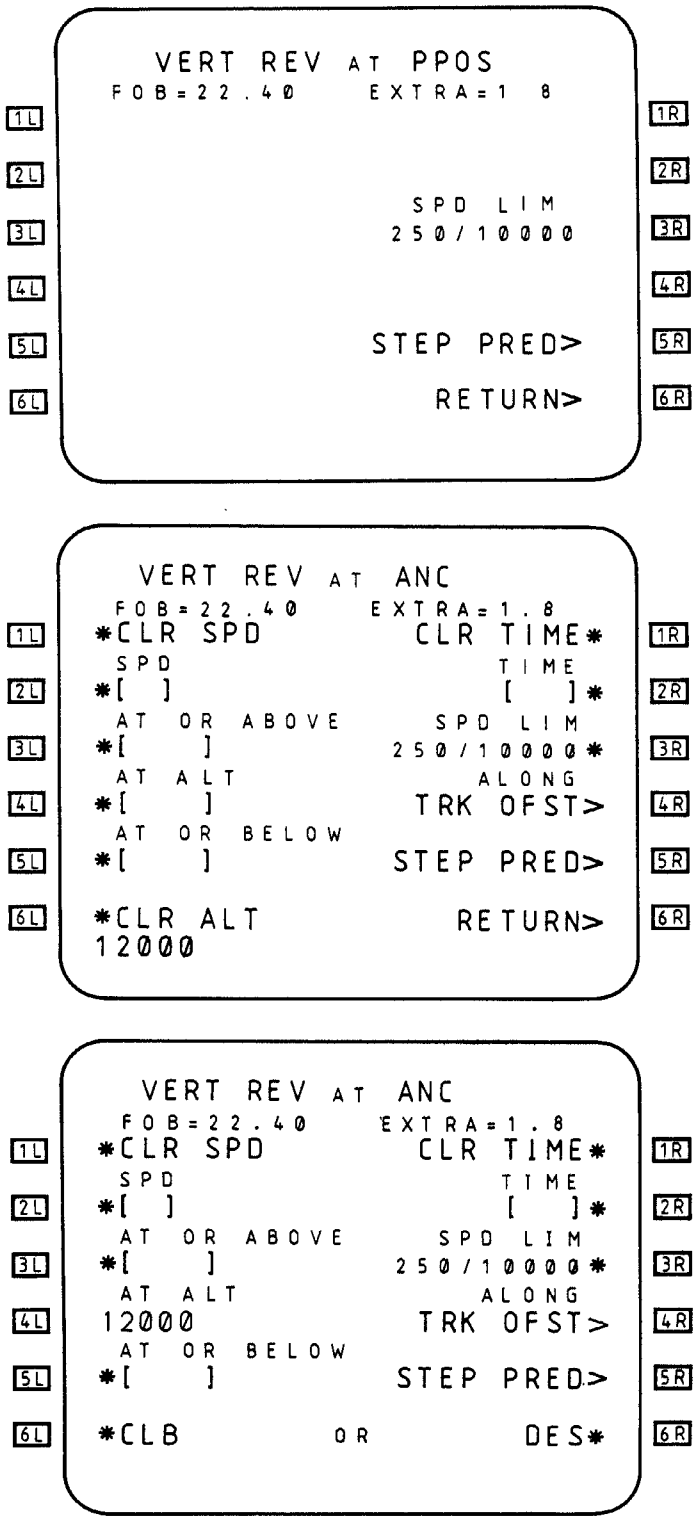
5R - STEP PRED - Allows access to the STEP PRED page. This prompt is displayed only if the revise point is the FROM waypoint or a fixed waypoint within the CRZ phase of the primary portion of the flight plan. If the T/C and T/D have not yet been calculated, this prompt will not be displayed.

If there are any constraints at the revise point when this page is accessed, those constraints will be shown in the appropriate field on this page in large front.

6R - RETURN - Returns the display to the last displayed F-PLN page.

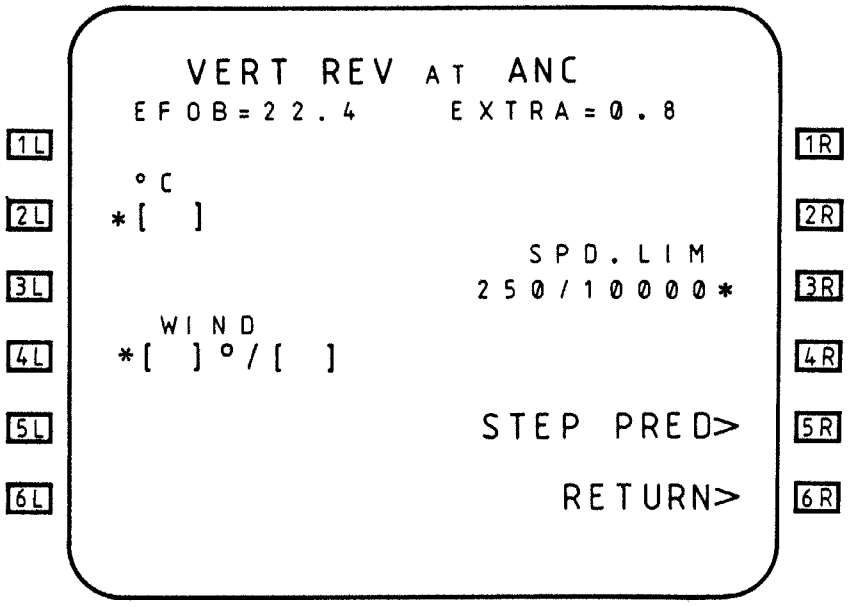
3 VERT REV page B. (Ref. Fig. 036)

- Access

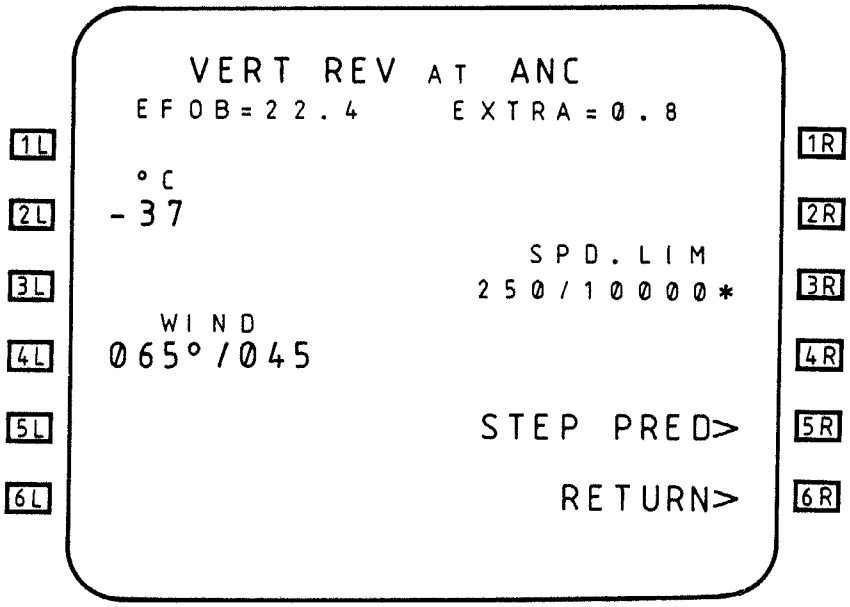


BM5 34 63 00 0 LKM0.00

Vertical Revise at P POS
Figure 035



VERT REV PAGE B (BLANK)



VERT REV PAGE B (COMPLETE)

BM5 34 63 00 0 BEMO

Vertical Revise Page B
Figure 036

RLS key on F-PLN Page B or SEC F-PLN Page B, with the scratchpad empty. Access will be allowed as specified in Tables 4, 10 and 11. Access is not allowed from the FROM waypoint or the ALONG TRACK OFST pseudo waypoint. Access will be allowed from the origin airport even though it is the "FROM" waypoint.
N/P key from VERT REV Page A.

- Purpose - Allows the flight crew to enter or modify the temperature and wind information waypoint by waypoint in the flight plan. Any changes affect only the flight plan that allowed access to this page.
- Data Fields
  Title - Same as VERT REV A.
  2L °C - Pilot may insert temperature at a waypoint for use by the FMC. This prompt is displayed only for fixed cruise waypoints, T/C, T/D, origin, and destination. If there is no T/C, or T/D in the flight plan, this prompt will be displayed only for the origin and destination. The fuel is displayed on the label line as on VERT REV Page A.
  4L - WIND - The pilot may insert true wind at a waypoint for use by the FMC. This wind is used to update the wind model. This prompt is displayed only for fixed cruise waypoints, T/C, T/D, origin, and destination. If there is no T/C or T/D in the flight plan, this prompt will be displayed only for the origin and destination.
  3R-6R - Same as VERT REV A except that 4R is blank.
  If a temperature or wind was previously entered at the revise point, it will be displayed in the appropriate data field on this page in large front.
  If a temperature or wind is entered at the T/C pseudo waypoint, the FMC considers this to be identical to a CRZ TEMP or CRZ WIND entry on the INIT page A or FUEL PREDICTION page. An entry here will actually change the data field on the INIT page A and on the FUEL PREDICTION page.

4 STEP PRED pages. (Ref. Fig. 037, 038)
- Access - STEP PRED LS key on either VERT REV Page (A or B).
- RLS key adjacent to the FROM waypoint on F-PLN page A or B of the active flight plan where the A/C is in the CRZ flight phase.
- Purpose - Allows the flight crew to predict the savings of a step climb or descent and insert that step into the flight plan.
- Data Fields

Title - The point at which the step will take place is displayed in columns 15 - 21. If the FROM waypoint is the revise point, the step point will be the optimum step point calculated by the FMC (Ref. Fig. 037), the time (in hours minutes) and distance (in nautical miles) to optimum step point from the present position are displayed in 1R. If the revise point was not the FROM waypoint, the step is at the revise point.(Ref. Fig. 038).

1L - STEP TO - The altitude input by the pilot that the aircraft will step to. If below the present altitude, a step descent will be predicted and if above the present altitude, a step climb will be predicted. This altitude must be above the highest descent altitude constraint or it will not be accepted and message "ENTRY OUT OF RANGE" will be displayed.

2L - Wind At Step altitude - This field solicits the wind at the Step To altitude as a pilot entry. This field displays the FMC calculated wind until the pilot enters a wind. The wind entry will be in large font if entered by the pilot or small font if calculated by the FMC.

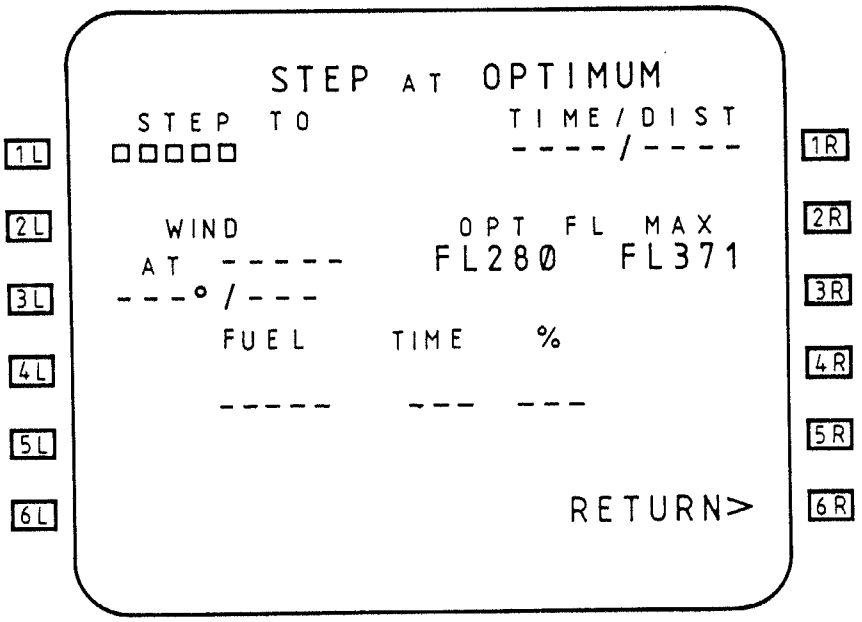
4L-4R - SAVINGS - The SAVINGS is displayed as fuel saved (in kilograms), time saved (in minutes) and percent saved. If there is a saving, the word SAVED will be displayed in line 4L-4R. If there is a loss, the word INCR will be displayed in 4L-4R. These are displayed in columns 2 - 6, 8 - 12, and 14 - 18, left justified.

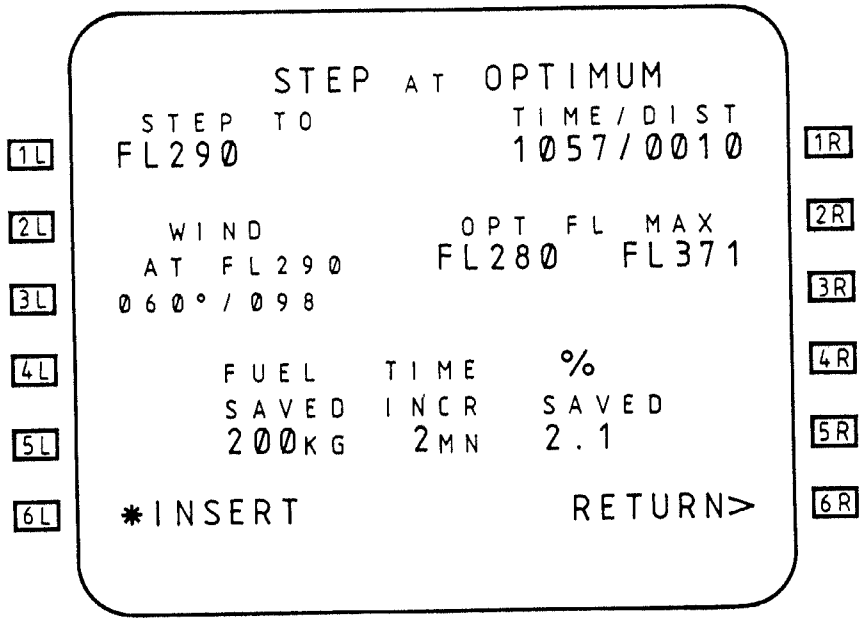
6L - INSERT - Pressing this LS key inserts the step into the flight plan and returns the display to the flight plan page that was last displayed. This prompt is only displayed if there has been an altitude entered into line 1L.

2R - Optimum and Maximum flight level - The present optimum and present maximun flight levels are displayed here for pilot reference. Maximum altitude will be displayed to the nearest 100 feet, while optimum altitude will be displayed to the nearest 1000 feet.

6R - RETURN - Pressing this LS key returns the display to the previously displayed flight plan page. If entries have been made on this page, pressing this key will not insert the STEP into the flight plan and on the next access to this page all entries will be deleted.

There is only one step allowed in the flight plan at any time. If a second step is inserted, the first step will be deleted.





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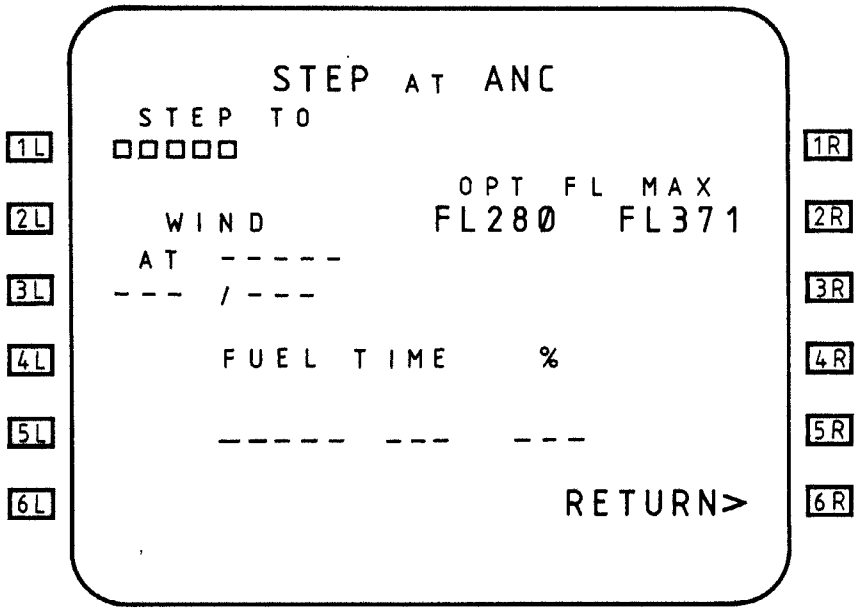
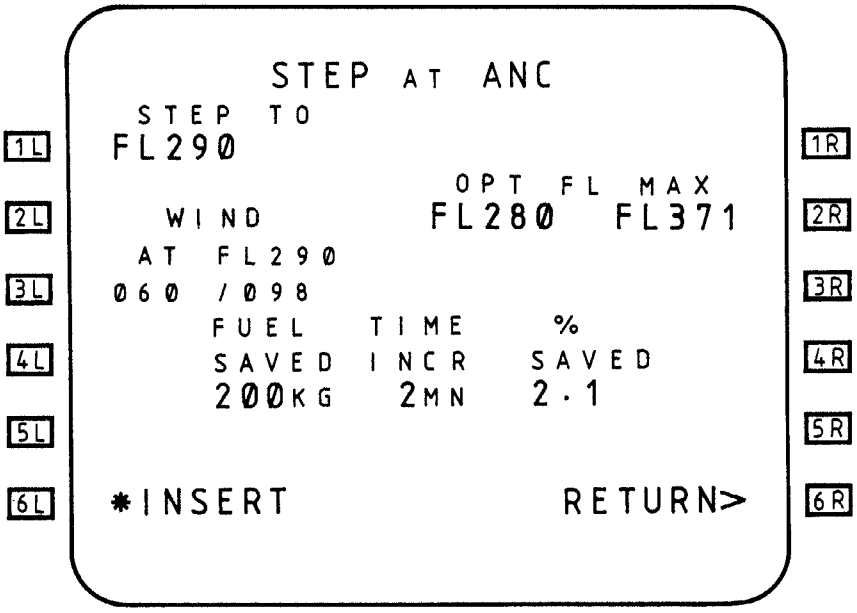
STEP Prediction at Optimum
Figure 037

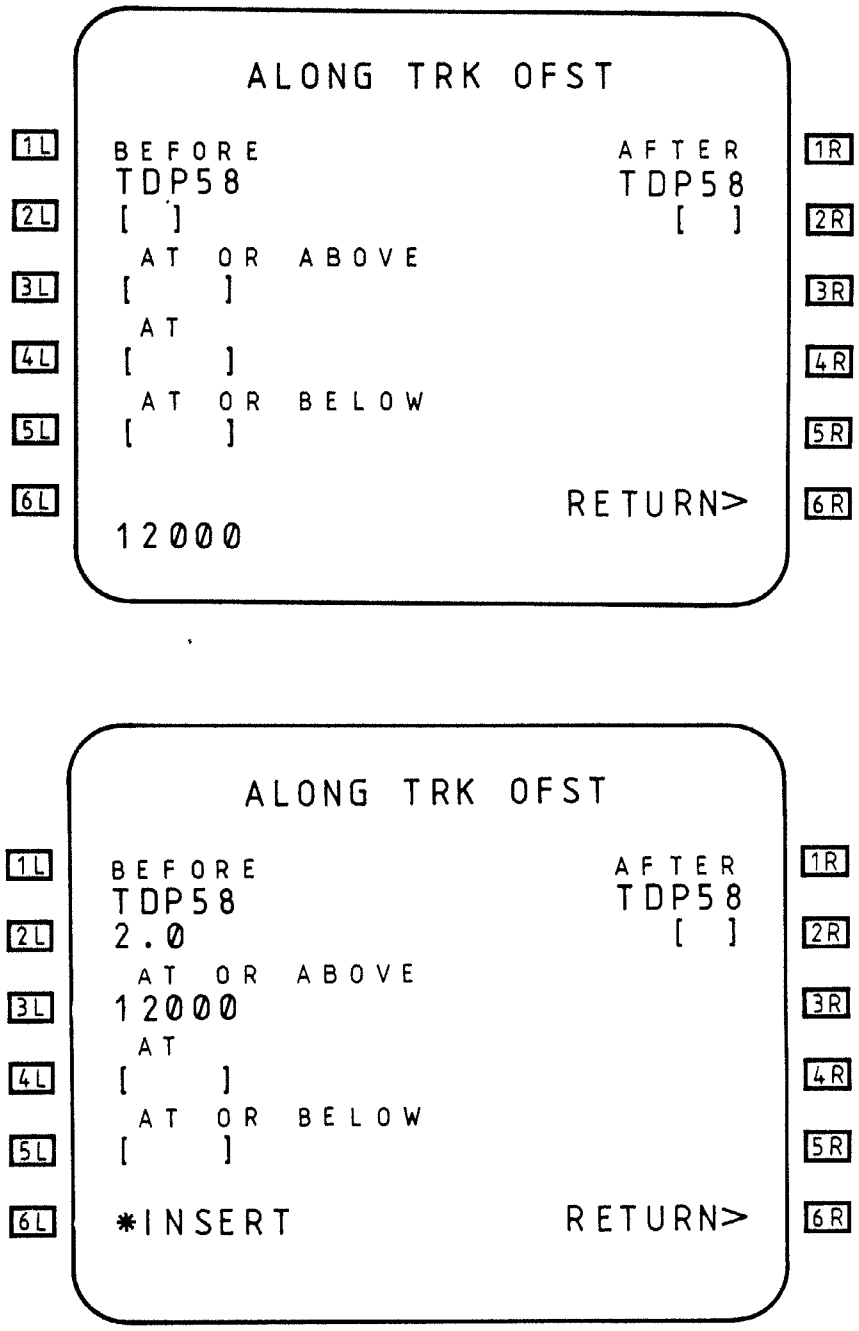




BM5 34 63 00 0 BGMO

STEP Prediction at WPT
Figure 038

5 ALONG TRK OFST page
(Ref. Fig. 039)
- Access
  LS key from VERT REV Page A.
  RLS key on F-PLN Page A adjacent to ALONG TRACK OFST pseudo-waypoint
- Purpose - Allow the pilot to enter or modify ALONG TRK OFST into the flight plan.
- Data Fields
  2L-2R (label line) - Displays the fixed waypoint which will define the ALONG TRK OFST waypoint. Left justified in columns 1 through 5, right justified in columns 20 through 24.
  2L - BEFORE - The distance before the revise waypoint where the ALONG TRK OFST waypoint will be defined.
  2R - AFTER - The distance after the revise waypoint where the ALONG TRK OFST waypoint will be defined.
  Both 2L and 2R fields cannot contain data at the same time. If data is entered into one field any previously entered data in the other field would be deleted.
  4L-6L - Same as altitude constraints on VERT REV Page A. Only one of these fields may contain data. If one is filled and another one is entered, the first one is deleted.
  4L - INSERT - This prompt is displayed when a distance (in 2L or 2R) and an altitude constraint (in 4L, 5L, or 6L) are entered. Pressing this LS key inserts the Along Track Offset into the flight plan and the display returns to the last displayed F-PLN page.
  6R - RETURN - Pressing this LS key returns the CDU display to the last displayed F-PLN page. Any entries made on this page are deleted and the Along Track Offset is not inserted. If the page was accessed from an along track offset waypoint the data fields should be filled in accordingly in large font.



BM5 34 63 00 0 BHMO

Along TRK OFST
Figure 039

(11)SECONDARY FLIGHT PLAN KEY (SEC F-PLN)

(a)SEC F-PLN index page (SEC INDEX). (Ref. Fig. 040)

- Access - SEC F-PLN key on CDU face
- Purpose - Allows access to secondary flight plan and functions related to the secondary flight plan
- Data Fields
- 1L - CO RTE - The entry and display rules for CO RTE are as defined for the INIT page A, except that this field defaults to entry prompts when no CO RTE number or FROM/TO is defined.

If any lateral revision, either via the SEC LAT REV pages or directly on the SEC F-PLN pages, modifies the flight plan defined by the original CO RTE then this field is blanked. If the flight plan is modified via the COPY ACTIVE function then the CO RTE number for the active flight plan is reflected here.

2L - SEC F-PLN - Allows access to SEC F-PLN Page A.

3L - COPY ACTIVE - pressing this LS Key copies everything from the active flight plan into the secondary flight plan. The display changes to the SEC F-PLN page A.

4L - CLEAR SEC - pressing this LS key clears the secondary flight plan.

This prompt is only displayed if there is at least one waypoint in the secondary flight plan.

5L - CRZ FL - The cruise flight level for the secondary flight plan is displayed and may be entered or changed. Entry of a CO RTE (either via 1L or RTE SEL page) with a stored CRZ FL will cause this field to revert to that CRZ FL. This field is displayed only if there is at least one waypoint in the secondary flight plan.

6L - ACTIVATE SEC - activates the secondary flight plan. If NAV is engaged, the conditions necessary for secondary flight plan sequencing must be satisfied, or activation is not allowed and message "NOT ALLOWED" is displayed. Upon activation, F-PLN page A (which was previously the SEC F-PLN page A) is displayed. This prompt is displayed only if there is at least one waypoint in the secondary flight plan.

1R - FROM/TO - The entry and display rules for FROM/TO are as defined for INIT page A, except that this field defaults to entry prompts before a FROM/TO is defined.

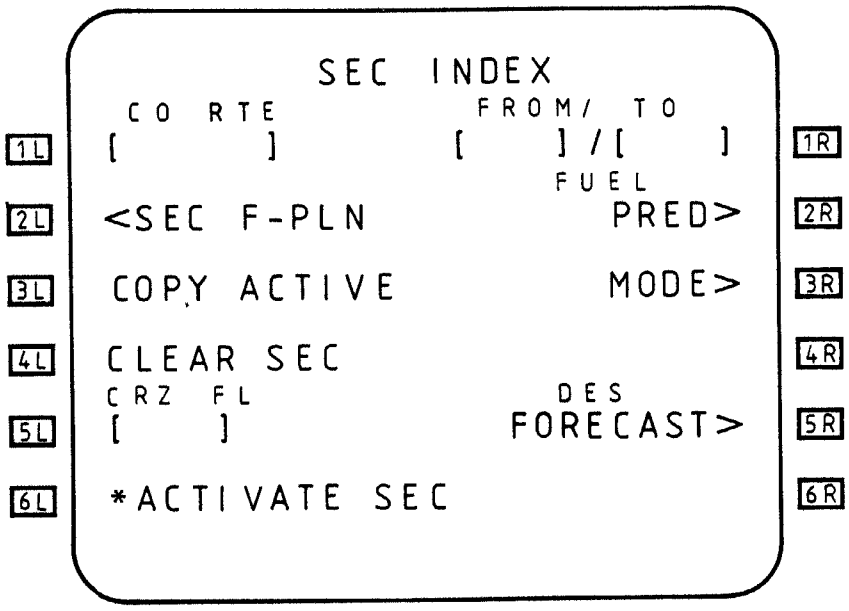
In addition, the FROM/TO can be defined as a result of copying the active flight plan into the secondary flight plan.

3R - MODE - Allows access to the SEC MODE page. Display is changed to that page. This prompt is displayed only if the conditions necessary for secondary flight plan predictions are satisfied.

5R - DES FORECAST - Allows access to the DES FORECAST page for the secondary flight plan. This prompt is displayed only if the conditions necessary for secondary flight plan predictions are satisfied.

2R - FUEL PRED - Allows access to the SEC FUEL PREDICTION page. This prompt is displayed only if the conditions necessary for secondary flight plan predictions are satisfied.

Entry into 1L or 1R initiates the comparison of AIDS date and active data base effectivity.



BM5 34 63 00 0 BJMO

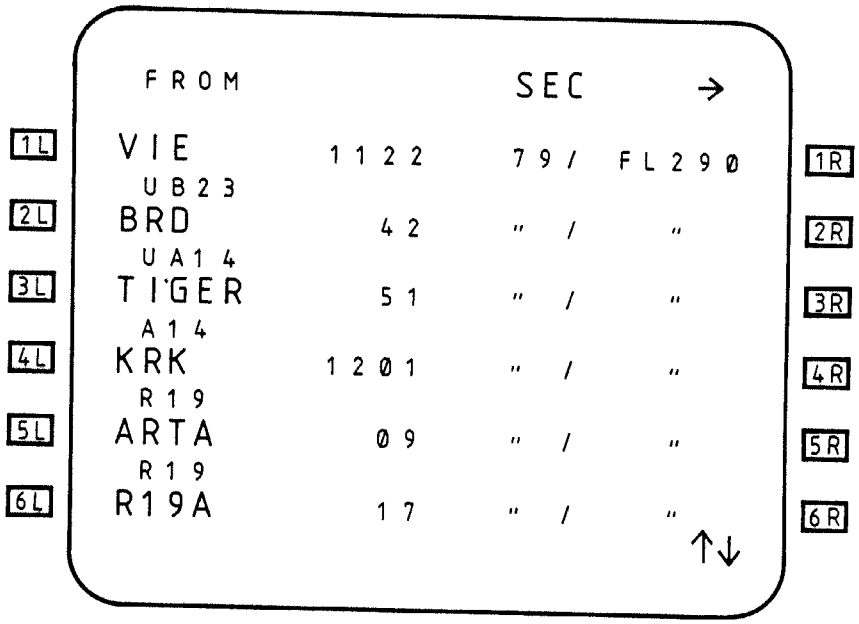
SEC INDEX Page
Figure 040

(b)SEC F-PLN page A.
(Ref. Fig. 041)
- Access
LS key on SEC INDEX page.
N/P from SEC F-PLN Page B.
Return from revise function if this page was the last displayed flight plan page.
- Purpose - same as active flight plan but may not have predictions displayed.
- Data Fields
Title - Same as active flight plan except that SEC is always displayed in columns 16 through 18.
1L-6L - same as the active F-PLN Page A
1R-6R - same as the active F-PLN Page A
Automatic vertical slewing when a leg switch occurs and displaying performance predictions will only happen if the secondary flight plan is copied from the active flight plan and the active leg in the active flight plan is identical to the active leg in the secondary flight plan. Furthermore, if (because of a lateral revise to either flight plan) the active lateral leg of the active flight plan becomes different from the first lateral leg in the secondary flight plan, all performance predictions will be dashes, and automatic vertical slewing will not occur.

(c)SEC F-PNL page B
(Ref. Fig. 042)
- Access - N/P from SEC F-PLN Page A.
Return from any revise function of this page was displayed last.
- Purpose - same as F-PLN Page B.
- Data Fields
Title - same as F-PLN Page B with SEC displayed in columns 16 through 18.
1L - 6L - same as active F-PLN Page B.
1R - 6R - same as active F-PLN Page B.
See SEC F-PLN Page A, (b).

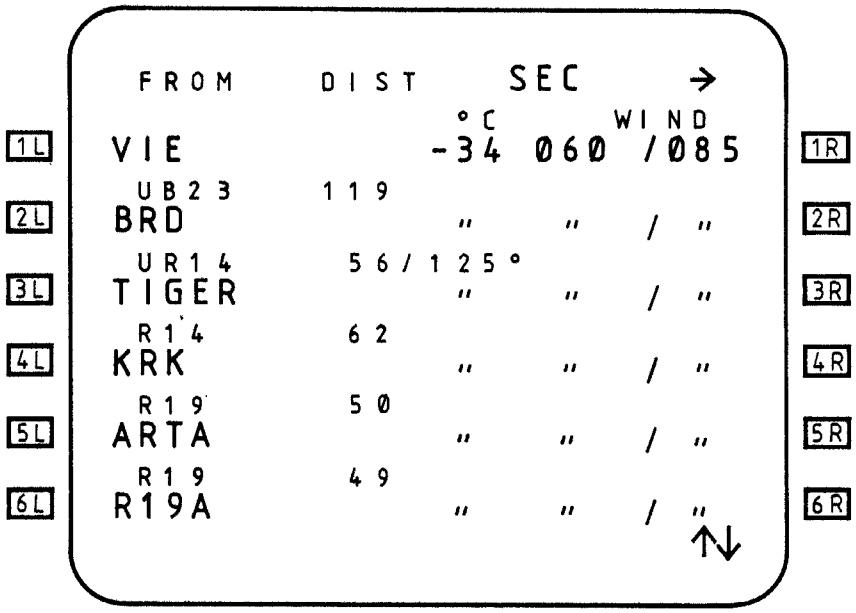
(d)Secondary LAT REV
When accessed from the SEC F-PLN, the LAT REV pages are displayed as defined for active LAT REV page except that asterisks (*) are not displayed.

(e)Secondary VERT REV
When accessed from the SEC F-PLAN, the VERT REV pages are displayed as defined for active VERT REV except that asterisks (*) are not displayed. Fuel predictions will only be displayed if the conditions necessary for secondary flight plan predictions are satisfied.



BM5 34 63 00 0 BKMO

Secondary F-PLN A
Figure 041



BM5 34 63 00 0 BLMO

Secondary F-PLN B
Figure 042

(f)SEC FUEL PREDICTION page

(Ref. Fig. 043)

- Access

  LS key from SEC INDEX page

  If this page is displayed and the conditions necessary for secondary flight plan predictions are no longer satisfied, then the display changes to the SEC INDEX page.

- Purpose

  To display fuel and time information pertaining to the secondary F-PLN

- Data fields

  This page has the same display format as the FUEL PREDICTION page with the addition of SEC in columns 2-4 of the title line.

  The entry rules are defined below.

  1L - 1R - predictions for ETA and fuel at the primary destination.

  2L - 2R - predictions for ETA and fuel at the alternate destination

  3L -GW - A/C gross weight is displayed here but cannot be changed

  If an entry is attempted, message "NOT ALLOWED" is displayed.

  3R - FOB - fuel on board and sensors used are displayed here but cannot be changed. If an entry is attempted, message "NOT ALLOWED" is displayed.

  4L - RTE RSV - The route reserve for the SEC F - PLN. Default and entry rules are as defined for the FUEL PREDICTION page.

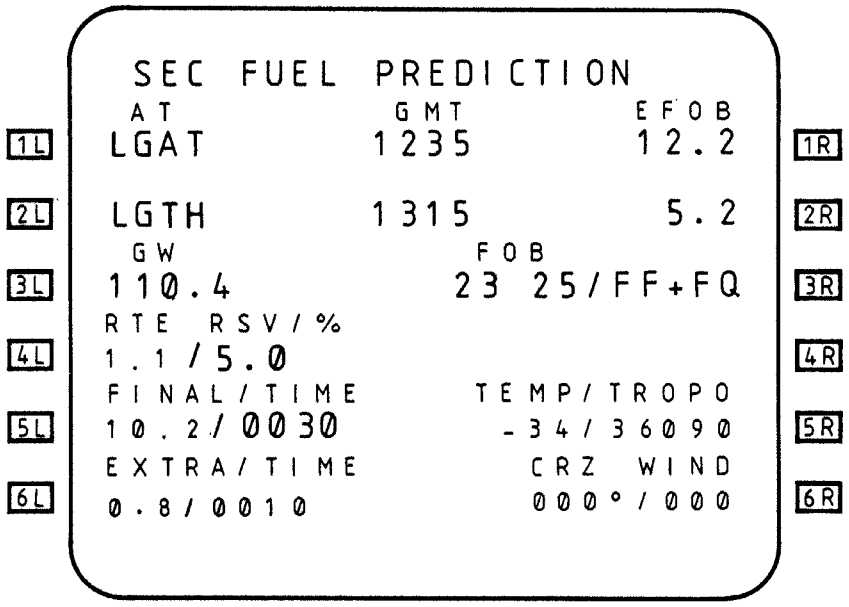
  5L - FINAL/TIME - The reserve holding fuel and time for the SEC F-PLN. Default and entry rules are as defined for the FUEL PREDICTION page.

  5R - TEMP/TROPO - The cruise temperature for the SEC F-PLN and/or the tropopause altitude.

  Default and entry rules are as defined for the FUEL PREDICTION page, except that an entry of tropopause altitude is not allowed. An attempt to enter a tropopause altitude will cause message "NOT ALLOWED" to be displayed. A cruise TEMP can be entered only if a CRZ FL has been defined for the SEC F-PLN.

  6L - EXTRA/TIME - The extra reserve fuel/time calculated for the SEC F-PLN. This value cannot be changed by the pilot. If an entry is attempted message "NOT ALLOWED" is displayed.

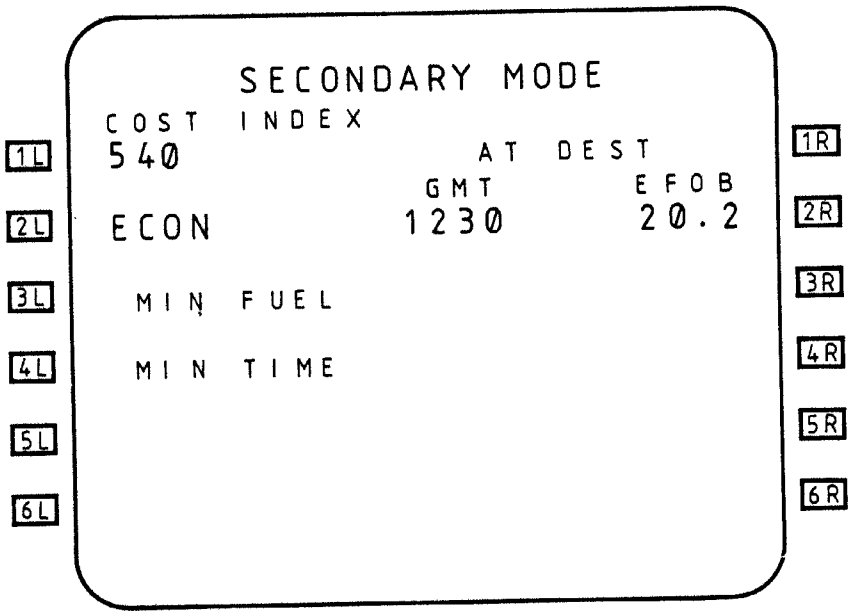
  6R - CRZ WIND. The cruise wind for the SEC F-PLN. Default and entry rules are as defined for the FUEL PREDICTION page. A CRZ WIND can be entered only if a CRZ FL has been defined for the SEC F-PLN



BM5 34 63 00 0 BLRO

SEC FUEL PREDICTION Page
Figure 043

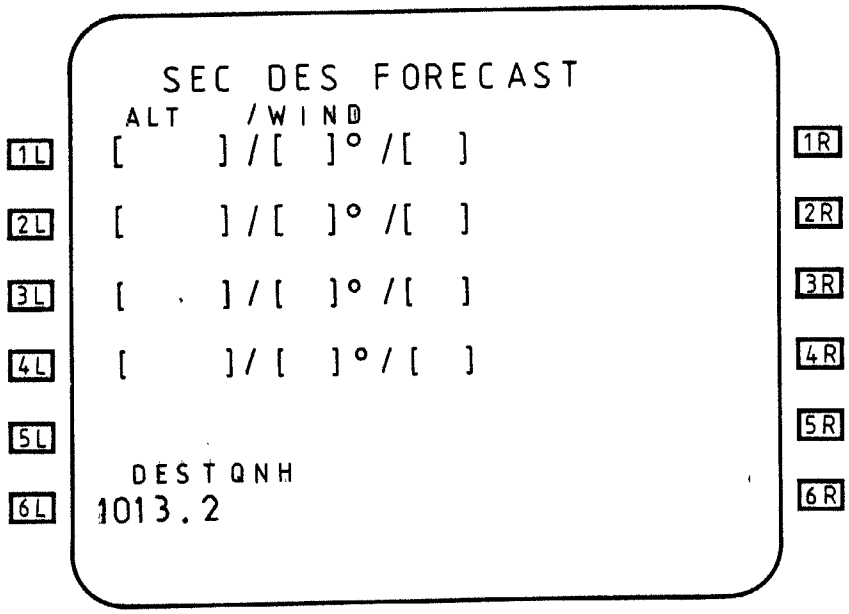
(g)SECONDARY MODE page
(Ref. Fig. 044)
- Access
LS key from SEC INDEX page.
If this page is displayed and the conditions necessary for SEC F-PLN predictions are no longer satisfied, there the display changes to the SEC INDEX page
- Purpose
To allow selection of a strategic performance mode for the SEC F-PLN, and to display predictions for Time and fuel at the secondary destination for the selected mode.
- Data fields
Title line. MODE is displayed in columns 16-19. When 2-engine predictions are displayed, SECONDARY is displayed in columns 6-14. For 1-engine predictions, SEC ENG OUT is displayed in columns 4-14
1L - COST INDEX - The cost index for the SEC F-PLN, may be entered or changed by the pilot. This field defaults to boxes until a COST INDEX is defined. This value may also be defined via a CO RTE entry on the SEC INDEX page, if the COST INDEX is contained in the CO RTE.
2L - 4L, 2R - 4R - as defined for the MODE page, except that predictions are displayed only for the selected strategic mode. The prediction fields for the non selected modes are blank.
The selected strategic mode and associated predictions are displayed in large fonts while the non-selected modes are displayed in small fonts. Pressing the left LS key alongside a mode will activate that mode.



BM5 34 63 00 0 BLWO

SECONDARY MODE Page
Figure 044

(h)SEC DES FORECAST page
(Ref. Fig. 045)
- Access.
LS key from SEC INDEX page.
If this page is displayed and the conditions necessary for SEC F-PLN predictions are no longer satisfied, then the display changes to the SEC INDEX page.
- Purpose
To enable the pilot to enter destination QNH and descent wind values for the SEC F-PLN.
- Data fields
This page has the same display format as the DES FORECAST page, with the addition SEC in columns 3-5 of title line. The entry rules are defined below.
1L - QNH - The destination QNH for the SEC F-PLN. The value defaults to standard (1013.2) but may be changed by the pilot.
3L - 6L - WINDS - Entry as defined for the DES FORECAST page. The winds entered on this page apply to the SEC F-PLN.



8M5 34 63 00 0 BLAO

SEC DES FORECAST Page
Figure 045

(12)PROGRESS KEY (PROG)
(a)PROG page
(Ref. Fig. 046)

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

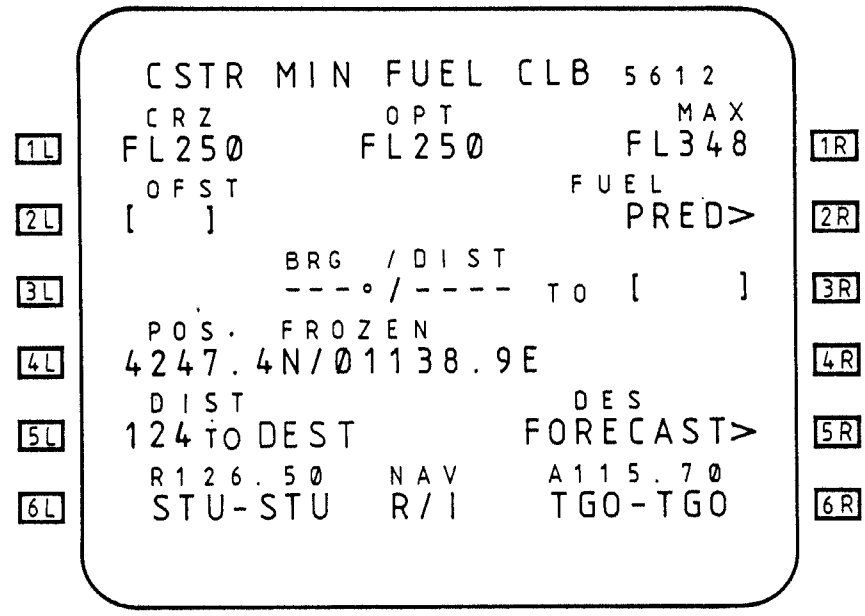
R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 047)

**ON A/C ALL

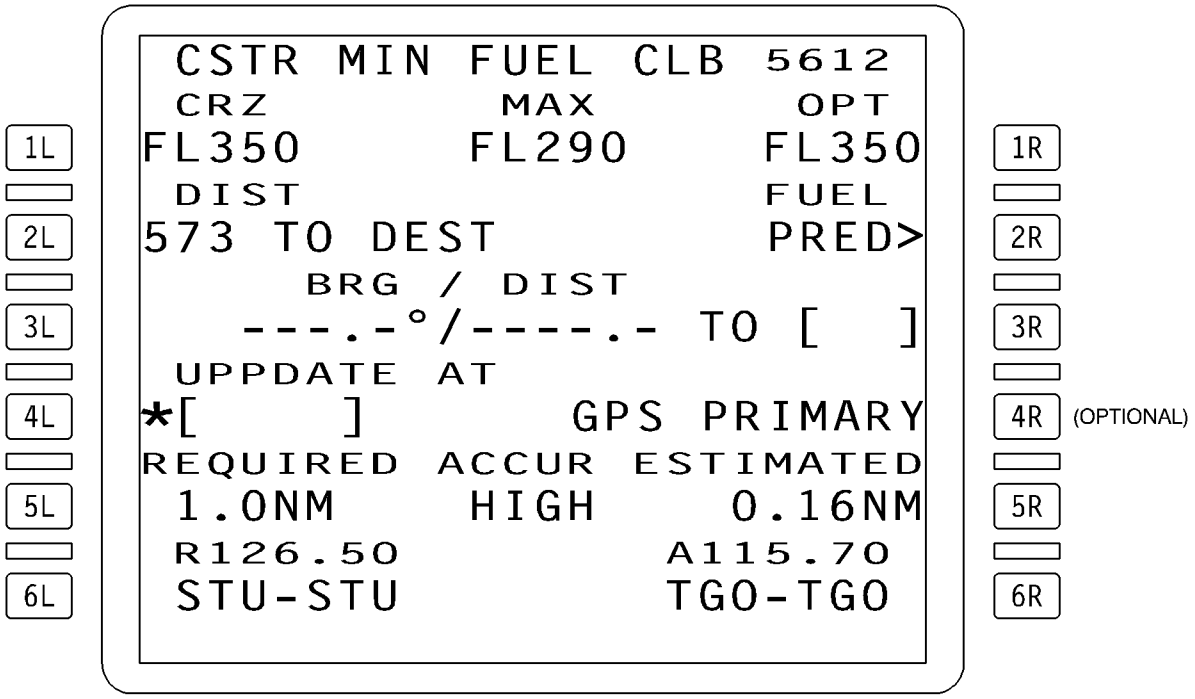
- Access - PROG key on CDU face
- Purpose - To display dynamic flight information about the active flight plan.
- Data Fields
  Title Line - Displays the performance mode and vertical phase, and flight number. The vertical phase is displayed in columns 16 through 18 and the mode is displayed (right justified) in columns 7 through 14. The flight number is displayed in column 20-23. If no flight number was entered on INIT page A the flight number field would be blank.
  The following vertical phases and mode combinations may be displayed through columns 6 to 21.

Vertical Phase	Mode
CLB (displayed if the A/C is in the DONE, PREFLIGHT, TAKEOFF, or CLB flight phase)	ECON MIN TIME MIN FUEL MAX CLB SPD ENG OUT
CRZ (displayed when the A/C is in the CRZ flight phase)	ECON MIN TIME MIN FUEL MAX END SPD ENG OUT IMM DES
DES	ECON



BM5 34 63 00 0 BLOO

PROGRESS Page
Figure 046



NOTE : OPT FL IS REPLACED BY VDEV DURING DESCENT AND APPROACH

BM5 34 63 00 0 FDM0 00

PROGRESS Page
Figure 047

R EFFECTIVITY: ALL

PIA

(displayed when the A/C is in the DES or APPR flight phase)	MIN TIME MIN FUEL MAX DES SPD ENG OUT IMM DES DECEL

Columns 2 through 5 of the title line are used to display submodes. The following submodes may occur :
- **CSTR** - indicates the **FMS** has deviated from the active performance mode speed in order to meet a constraint or limit.
- **S/C** - indicates the aircraft is doing a step climb.
- **S/D** - indicates the aircraft is doing a step descent.
- **???** - indicates the aircraft is between the target altitude and the **CLR ALT**. (e.g : aircraft in **CLIMB** phase and the pilot dials the **FCU** altitude below the aircraft altitude)
- **D/D** - indicates the aircraft is doing a driftdown.

1L - Cruise flight level. Cruise flight level is displayed to 100 ft resolution in columns 1 - 5. The pilot may enter a new cruise altitude using LS key **1L**. This field is identical to **CRZ FL** on **INIT A**. The logic for displaying dashes, boxes or **CRZ FL** data is identical to the **INIT** page **A CRZ FL** field with the following exceptions.
If dashes are being displayed during the flight phase transitions from **PREFLIGHT** or **DONE** to **TAKE OFF** or **CLB**, then the field changes to display boxes, thereby allowing entry of a **CRZ FL**.
Dashes will be displayed when the aircraft transitions to descent. In this case an entry will be allowed if it is at or below present aircraft altitude, otherwise it will be rejected and message 9 displayed (entry out of range). **A CRZ FL** will also be defined during an **OPEN** profile descent if the **CLR ALT** is set above the present **A/C ALT**.

1R - Optimum and Maximum Flight Levels. The calculated present optimum flight level is displayed to the nearest 100 ft. in columns 10-14. This field defaults to dashes if a calculated value is not available. The calculated present maximum altitude is displayed to the nearest 100 ft. in columns 20-24. This field defaults to dashes if a calculated value is not available.

2L - OFST - A parallel offset to the active flight plan may be entered here. This field (including "**OFST**" on the label line) is displayed and entry allowed if the following conditions are both true :
- the active leg is a **CF, TF, FM** or **DF** (excluding conditional **CF** and **TF** legs).
- the active leg termination waypoint is not a destination runway in the active flight plan.

If an offset has not been entered then entry brackets are displayed. The offset may be entered to the left or right of the flight plan path.
If accepted the entered offset value replaces the brackets. When an offset is cancelled the offset is no longer displayed here though the entry brackets will again be displayed if conditions above are true.

4L-4R - The aircraft present position is displayed here as **LAT/LONG**. Pressing LS key **4L** with the scratchpad empty will freeze the **LAT/LONG** display (but will not freeze the position filters) and cause **POS FROZEN** to be displayed in the label line.
Pressing LS key **4L** with the scratchpad empty and the position display frozen will unfreeze the display to again indicate aircraft present position and blank the label line. The aircraft present position may

also be updated via this field (4L - 4R). The pilot may update the position by entering a LAT/LONG, WAYPOINT IDENT, NAVAID IDENT, or PLACE/BRG/DIST into 4L. The entered LAT/LONG will be displayed (frozen) in 4L (the LAT/LONG of the navaid, WAYPOINT or PLACE/BRG/DIST is calculated or looked up) and UPDATE * is displayed in 4R. When LS key 4R is pressed the position filters are re-initialized to the entered LAT/LONG and the field 4L displays the output of the updated filters. If the UPDATEis cleared (using the CLR function) the filters are not re-initialized and the display in 4L reverts to aircraft present position as defined by the position filters. If A/C present position is invalid, then an entry into 4L is not allowed and message "NOT ALLOWED" is displayed.

6L-6R - TUNED NAVAIDS - The two stations chosen for display on the RMI are displayed here. The identifier and frequency, as well as how the station was tuned (tuning identifier) are displayed. 6L corresponds to the left FMCS (FMC1) and 6R corresponds to the right FMCS (FMC2).

The offside information (e.g., the information for FMC1 displayed on CDU2) is supplied by the offside FMC. Therefore, the offside information is not displayed when in the Independent mode of operation. When the appropriate FMC's captain's Manual/Auto tune discrete is in Manual, then the information for the manually tuned navaid is displayed with the tuning identifier as "M". If "AUTO" and one of the Directed frequency outputs has the "Display bit" set to "1", then the information for that Navaid is displayed along with "A" or "R" as appropriate. Otherwise the field is blank.

The tuning identifier is as follows.

A - Automatically selected for display by the FMC, but not selected by the pilot for remote tuning.

M - Manually tuned by the pilot through the VHF/NAV control panel. When the CAPTAIN MANUAL/AUTOTUNE discrete is in manual, the tunning identifier and frequency are displayed.
The NAV AID IDENT is displayed if valid, dashed otherwise.

R - Remotely tuned by pilot via entry of the navaid identifier into this field. Entry into 6L is for FMC 1, and entry into 6R is for FMC2. If the selected FMC has its Captain's Manual/Autotune discrete input at "MANUAL" or if in the Independent mode of operation and the offside FMC is selected, then the entry is rejected and message "NOT ALLOWED" is displayed. If the entered navaid is not in the data base, message "NOT IN DATA BASE" will be displayed.
If the entered navaid has been deselected on the NAVAIDS page the entry is rejected and message "NOT ALLOWED" is displayed. This field may be cleared to return the FMCS to autotuning. The remotely tuned navaid is also cleared if the second data base is activated, or if the remotely tuned navaid is deselected on the NAVAIDS page.
In these cases the tuning identifier reverts to "A" and a new navaid identifier will be displayed. Only the following classes of navaids may be remotely tuned. If any other class of navaid is entered, message "ENTRY OUT OF RANGE" will be displa-

yed.
VOR only
Non collocated VOR DME
VORTAC
DME only
Collocated VOR DME
The NAVAID IDENT is displayed as follows (NAV in the ident)
NAV-NAV for VOR DME or VORTAC navaid
NAV for VOR only navaid
- NAV for DME only navaid
The navaid class used to derive this display is as defined in the NAV data base or defined navaids list.
The NAV position update mode the FMC is using for navigation is displayed in columns 11-14 left justified. The following modes may be displayed :
R - Radio only
I - Inertial only
R/I - Radio/inertial
DR - Dead reackoning
NONE is displayed when no navigation mode is possible
2R - FUEL PRED - This LS key allows access to the FUEL PREDICTION page. This prompt is only displayed after engine start and before the DONE flight phase.
3R - BRG/DIST to WPT - This function allows the pilot to enter a waypoint, navaid, runway, or airport ident, LAT/LONG, or PLACE/BRG/DIST, and the FMC will calculate and display the BRG/DIST (in whole digits) to that waypoint from the present position.
This calculation is updated every two seconds and is not deleted when a new CDU page is accessed. Use of the CLR key reverts the field to entry prompt.
The BRG is displayed to the nearest degree in columns 7-9 followed by the degree symbol (°). The DIST is displayed to the nearest nautical mile, left justified, in columns 12-15. The ident is displayed, left justified, in columns 20-24. If a LAT/LONG or PLACE/BRG/DIST is entered then this field will display ENTRY in large font. Insertion of LAT/LONG or PLACE/BRG/DIST does not impact the list of pilot defined waypoints.
5R - DES FORECAST - This LS key allows access to the DES FORECAST page for the active flight plan.
5L - DIST to DEST - Aircraft Distance to Destination is displayed in large font, right justified in columns 1 through 4.
Dashes are displayed when an active primary destination does not exist or leg distance updating is not being performed.

(b)FUEL PREDICTION page

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- Access - PROG key on CDU face
- Purpose - To display dynamic flight information about the active flight plan.
- Data Fields
  Title Line - Displays the performance mode and vertical phase, and flight number. The vertical phase is displayed in columns 16 through 18 and the mode is displayed (right justified) in columns 7 through 14. The flight number is displayed in column 20-23. If no flight number was entered on INIT page A the flight number field would be blank.
  The following vertical phases and mode combinations may be displayed through columns 6 to 21.

Vertical Phase	Mode
CLB (displayed if the A/C is in the DONE, PREFLIGHT, TAKEOFF, or CLB flight phase)	ECON MIN TIME MIN FUEL MAX CLB SPD ENG OUT
CRZ (displayed when the A/C is in the CRZ flight phase)	ECON MIN TIME MIN FUEL MAX END SPD ENG OUT IMM DES
DES (displayed when the A/C is in the DES or APPR flight phase)	ECON MIN TIME MIN FUEL MAX DES SPD ENG OUT IMM DES

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Columns 2 through 5 of the title line are used to display submodes. The following submodes may occur :
- CSTR - indicates the FMS has deviated from the active performance mode speed in order to meet a constraint or limit.
- S/C - indicates the aircraft is doing a step climb.
- S/D - indicates the aircraft is doing a step descent.
- ??? - indicates the aircraft is between the target altitude and the CLR ALT. (e.g : aircraft in CLIMB phase and the pilot dials the FCU altitude below the aircraft altitude)
- D/D - indicates the aircraft is doing a driftdown.

1L - Cruise flight level. Cruise flight level is displayed to 100 ft resolution in columns 1 - 5. The pilot may enter a new cruise altitude using LS key 1L. This field is identical to CRZ FL on INIT A. The logic for displaying dashes, boxes or CRZ FL data is identical to the INIT page A CRZ FL field with the following exceptions. If dashes are being displayed during the flight phase transitions from PREFLIGHT or DONE to TAKE OFF or CLB, then the field changes to display boxes, thereby allowing entry of a CRZ FL. Dashes will be displayed when the aircraft transitions to descent. In this case an entry will be allowed if it is at or below present aircraft altitude, otherwise it will be rejected and message 9 displayed (entry out of range). A CRZ FL will also be defined during an OPEN profile descent if the CLR ALT is set above the present A/C ALT.

1R - maximum and optimum flight levels are displayed to the nearest flight level (100 ft). When flight phase is DESCENT or APPROACH, VDEV is displayed instead of OPT FL. VDEV is the difference between aircraft current altitude minus the FM descent/approach profile altitude at current aircraft position.

2L - DIST TO DEST : distance to destination is measured along the F-PLN. Dashes are displayed if it is not available.

2R - FUEL PRED prompt : allows access to the FUEL PRED page.

3L/3R - BRG/DIST TO WPT : allows the calculation of magnetic bearing and distance from current onside position to either a waypoint, navaid, runway, airport, LAT/LONG, or PLACE/BRG/DIST. BRG/DIST is refreshed every 2 seconds.

4L/4R - UPDATE AT : allows the entry of a waypoint, navaid, LAT/LONG or PLACE/BRG/DIST to update FMC positions (on both sides). After entry in 4L, a confirm prompt is displayed in 4R to perform the actual update.

4R - GPS PRIMARY status is displayed when both accuracy and integrity requirements are met (accuracy is HIGH and requirements of TSO C129 are met). This status is displayed only with the GPS option.

5L/5R - Required accuracy : criterion used as a threshold between HIGH and LOW navigation accurary. A default value is computed by the system, which can be modified.
Navigation accuracy : HIGH or LOW depending on whether required accuracy is greater or smaller than estimated accuracy.
Estimated accuracy : computed by the FMC, cannot be modified.

6L-6R - TUNED NAVAIDS - The two stations chosen for display on the RMI are displayed here. The identifier and frequency, as well as how

the station was tuned (tuning identifier) are displayed. 6L corresponds to the left FMCS (FMC1) and 6R corresponds to the right FMCS (FMC2).
The offside information (e.g., the information for FMC1 displayed on CDU2) is supplied by the offside FMC. Therefore, the offside information is not displayed when in the Independent mode of operation.
When the appropriate FMC's captain's Manual/Auto tune discrete is in Manual, then the information for the manually tuned navaid is displayed with the tuning identifier as "M". If "AUTO" and one of the Directed frequency outputs has the "Display bit" set to "1", then the information for that Navaid is displayed along with "A" or "R" as appropriate. Otherwise the field is blank.
The tuning identifier is as follows.

A - Automatically selected for display by the FMC, but not selected by the pilot for remote tuning.

M - Manually tuned by the pilot through the VHF/NAV control panel. When the CAPTAIN MANUAL/AUTOTUNE discrete is in manual, the tunning identifier and frequency are displayed.
The NAV AID IDENT is displayed if valid, dashed otherwise.

R - Remotely tuned by pilot via entry of the navaid identifier into this field. Entry into 6L is for FMC 1, and entry into 6R is for FMC2. If the selected FMC has its Captain's Manual/Autotune discrete input at "MANUAL" or if in the Independent mode of operation and the offside FMC is selected, then the entry is rejected and message "NOT ALLOWED" is displayed. If the entered navaid is not in the data base, message "NOT IN DATA BASE" will be displayed.
If the entered navaid has been deselected on the NAVAIDS page the entry is rejected and message "NOT ALLOWED" is displayed.
This field may be cleared to return the FMCS to autotuning. The remotely tuned navaid is also cleared if the second data base is activated, or if the remotely tuned navaid is deselected on the NAVAIDS page.
In these cases the tuning identifier reverts to "A" and a new navaid identifier will be displayed. Only the following classes of navaids may be remotely tuned. If any other class of navaid is entered, message "ENTRY OUT OF RANGE" will be displayed.
VOR only
Non collocated VOR DME
VORTAC
DME only
Collocated VOR DME

The NAVAID IDENT is displayed as follows (NAV in the ident)
NAV-NAV for VOR DME or VORTAC navaid
NAV for VOR only navaid
- NAV for DME only navaid
The navaid class used to derive this display is as defined in the NAV data base or defined navaids list.
2L - DIST to DEST - Aircraft Distance to Destination is displayed in large font, right justified in columns 1 through 4.

Dashes are displayed when an active primary destination does not exist or leg distance updating is not being performed.

**ON A/C ALL

(Ref. Fig. 048)
- Access - LS key from PROG page
  Engine start occu while the INIT page B is displayed.
- Purpose - Display fuel information pertaining to the active F-PLN for flight crew reference.
- Data Fields
  1L - 1R - Prediction for time and fuel at the primary destination. When time predictions are ETA, columns 11-14 of the label line of 1L - 1R displays GMT (right justified). When predictions are ETE the same field displays TIME. If there is no destination airport, then NONE is displayed in 1L and both time and fuel predictions will be dashes. The time is displayed, right justified, in columns 11 - 14. The fuel is displayed, right justified, in columns 21 - 24.
  2L-2R - Prediction for time and fuel at the alternate destination based on present active mode predictions. If there is no ALTN F-PLN these fields will be dashes. The time is displayed, right justified, in columns 11 - 14. The fuel is displayed, right justified, in columns 21 - 24.

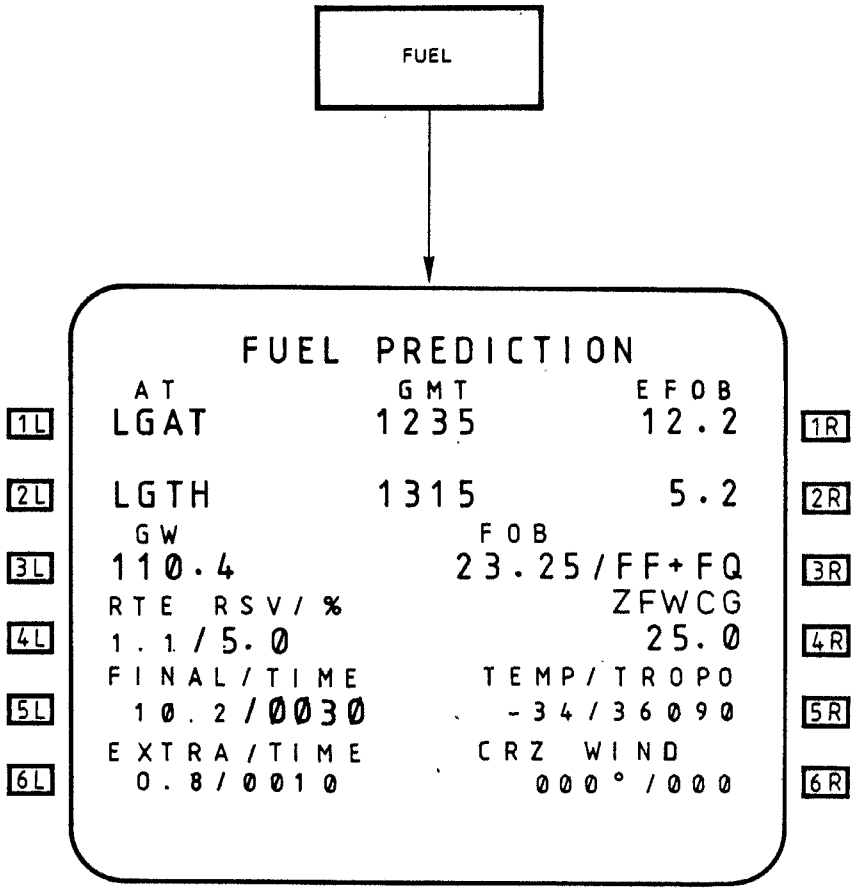
**ON A/C 001-100,

3L- GW - The gross weight is displayed here in thousands of kilograms (to the nearest 0.1 increment, left justified) as NNN.N. Leading zeros are omitted. The field displays dashes and entry is not allowed if FOB is not being calculated. The field displays boxes if FOB is being calculated but zero fuel weight has not been initialized. The pilot may initialize gross weight, and hence zero fuel weight by entering a value into this field whenever dashes are not displayed.
An entry of gross weight may also cause the Cost Index to default.
3R- FOB - The fuel on board is displayed here in thousands of kilograms (to the nearest.05 increment) as NN-NN in columns 14-18.

**ON A/C 101-200,

3L- GW - The gross weight is displayed here in thousands of pounds (to the nearest 0.1 increment, left justified) as NNN.N. Leading zeros are omitted. The field displays dashes and entry is not allowed if FOB is not being calculated. The field displays boxes if FOB is being calculated but zero fuel weight has not been initialized. The pilot may initialize gross weight, and hence zero fuel weight by entering a value into this field whenever dashes are not displayed.
An entry of gross weight may also cause the Cost Index to default.
3R- FOB - The fuel on board is displayed here in thousands of pounds (to the nearest.05 increment) as NN-NN in columns 14-18.

**ON A/C ALL



BM5 34 63 00 0 LTP0 -24 -19
DM5

Fuel Prediction Page
Figure 048

Leading zeros are omitted and the field is right justified. In column 19 a slash sign is displayed. In column 20-24 the sensors used by the FMC for FOB calculations are displayed, left justified. Where both FF and FQ sensors are used in the FOB computations then "FF + FQ" is displayed. The pilot may choose to select only one of the sensor types for the computation (thus deleting the other) by entering the memonic (/FF for fuel flow, /FQ for fuel quantity) of the sensor to be used into the scratchpad and pressing this LS key. The selected sensor must be valid, otherwise entry is rejected and message "SENSOR IS INVALID" is displayed. A subsequent entry of /FF + FQ or /FQ + FF, or entering CLR into this field would cause those sensors that are valid to be displayed. If both sensors are invalid, then entry is rejected and message "SENSOR IS INVALID" is displayed. Prior to selection, those sensors which are valid are displayed. If no sensors are valid, or the selected sensor subsequently becomes invalid, then columns 20-24 default to dashes. The FOB can be re-initialized by entering a value into this field only if FQ + FF or FF are being displayed as sensors used. Entry of a new FOB automatically deletes the FQ sensor from the calculation. If FQ is displayed as the only sensor used and FOB is entered, then entry is rejected and message "NOT ALLOWED" is displayed. Columns 14-18 default to dashes if FOB is not being calculated.

**ON A/C 001-100,

4L - RTE RSV - The trip reserves expressed as actual fuel in thousands of kilograms or as a percentage of the remaining trip fuel. The displayed values may be changed by the pilot, but only one may be entered at a time. To enter RTE RSV fuel weight, enter the weight via the scratchpad. To enter the % of trip fuel, enter /N.N. Entry of either a weight value or a % value must be checked against the upper and lower limits of RTE RSV specified by the data base. If a pilot entry exceeds a limit, the entry is limited and the limited value is displayed in large font. A new percentage value is calculated using the limited value of RTE RSV and the TRIP fuel. The new percentage is displayed in small font. This data is identical to the RTE RSV on the INIT page B.

**ON A/C 101-200,

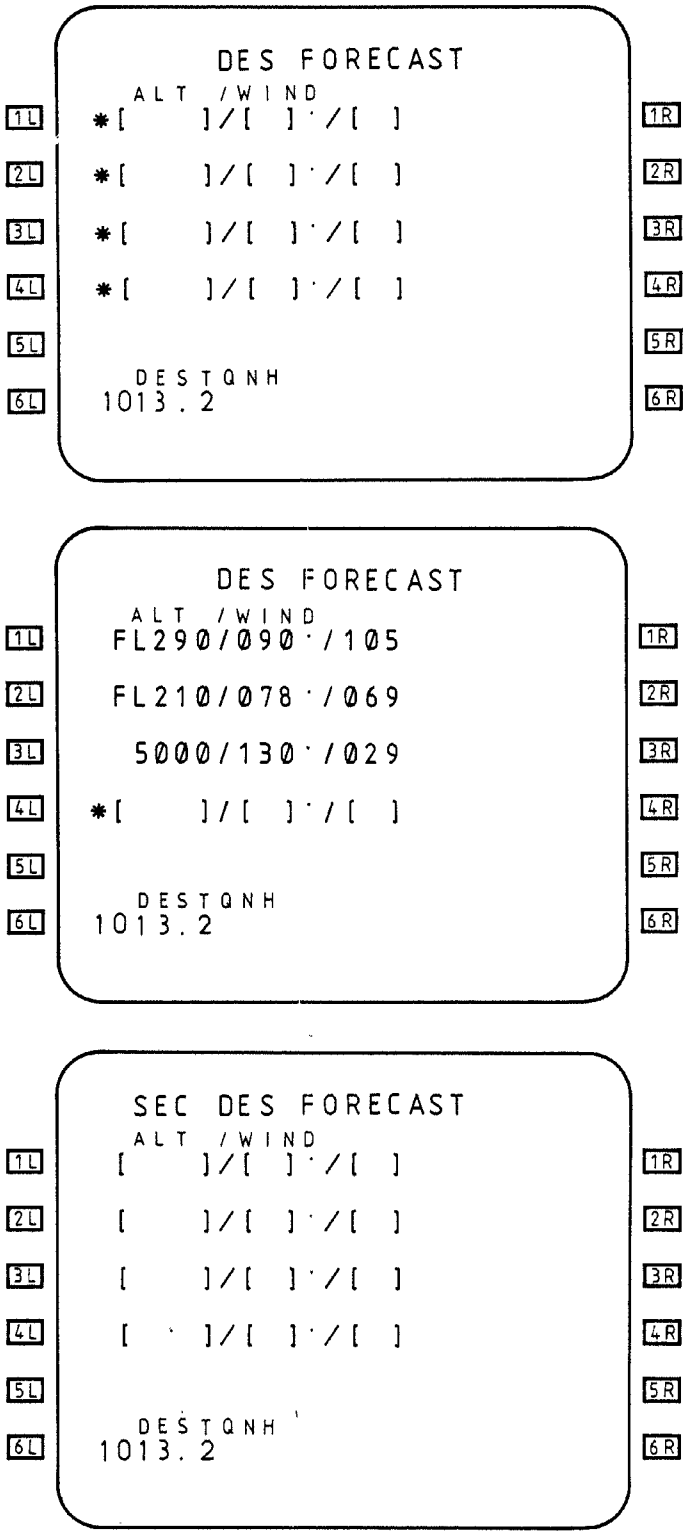
4L - RTE RSV - The trip reserves expressed as actual fuel in thousands of pounds or as a percentage of the remaining trip fuel. The displayed values may be changed by the pilot, but only one may be entered at a time. To enter RTE RSV fuel weight, enter the weight via the scratchpad. To enter the % of trip fuel, enter /N.N. Entry of either a weight value or a % value must be checked against the upper and lower limits of RTE RSV specified by the data base. If a pilot entry exceeds a limit, the entry is limited and the limited value is displayed in large font. A new percentage value is calculated using the limited value of RTE RSV and the TRIP fuel. The new percentage is displayed in small font. This data is identical

to the RTE RSV on the INIT page B.

**ON A/C ALL

4R - ZFWCG - Identical to ZFWCG on init page B. Can be changed by the crew but is displayed only during PREFLIGHT phase, otherwise it is blank.
5L - FINAL/TIME - The reserve holding fuel and time. These data are identical to the FINAL/TIME on INIT Page B. The pilot may change this data.
6L - EXTRA/TIME - The extra reserve fuel is displayed here as calculated in Paragraph 1.6. This field is identical in format to the EXTRA/TIME on INIT page B but the value cannot be changed by the pilot. If an entry is attempted, message "NOT ALLOWED" is displayed.
5R - TEMP/TROPO - The cruise temperature and/or tropopause altitude are displayed and can be entered or changed here. This field is identical to the TEMP/TROPO on the INIT page A.
6R - CRZ WIND - The cruise wind is displayed and can be entered or changed here. This field is identical to the CRZ WIND on the INIT Page A.

(c)DES FORECAST page
(Ref. Fig. 049)
- Access - LS key on PROG Page
LS key from SEC INDEX Page for SEC F-PLN.
- Purpose - Enable the pilot to enter destination QNH and descent wind values for the active F-PLN.
- Data Fields
1L - QNH - The destination QNH is displayed and can be entered or changed here. This field is identical to the DEST QNH field on the INIT page A.
3L - 6L-WINDS - The pilot inserts the altitude and wind for that altitude as an input to the FMC wind model. The wind may be entered at up to four different altitudes.



BM5 34 63 00 0 LMM0 00

Descent Forecast
Figure 049

(13)TAKEOFF/APPROACH KEY (TO/APPR)
(a)TAKEOFF page

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

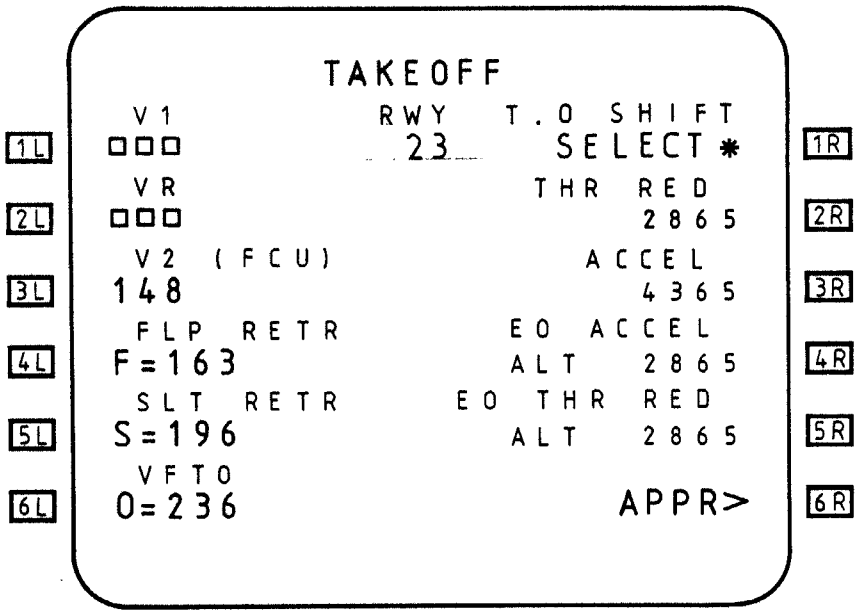
R Post SB 34-2151 For A/C 101-200,

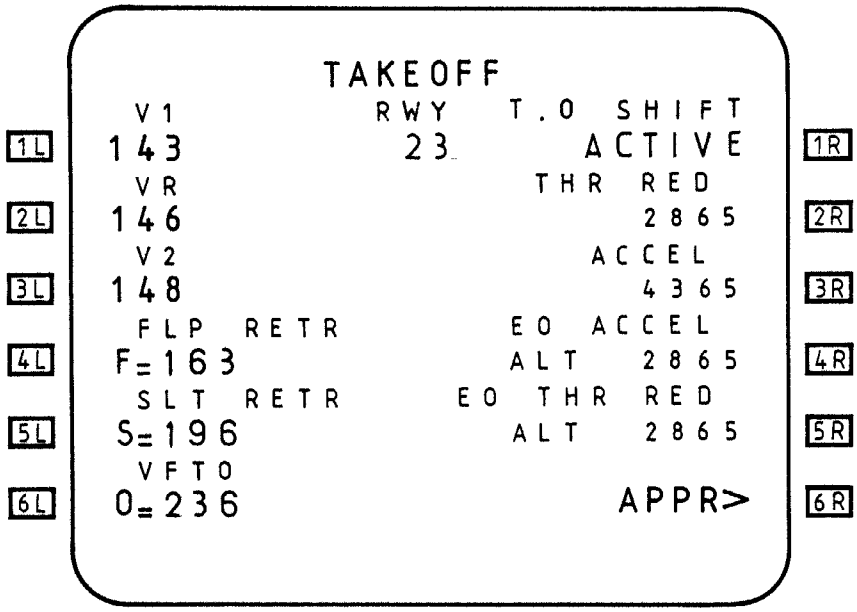
- Access - LS key from **MODE** page for primary **F-PLN.**
- Purpose - Enable the pilot to enter destination **QNH** and descent wind values for the active **F-PLN.**
- Data Fields
  1L - **QNH** - The destination **QNH** is displayed and can be entered or changed here. This field is identical to the **DEST QNH** field on the **INIT** page **A.**
  3L - 6L-**WINDS** - The pilot inserts the altitude and wind for that altitude as an input to the **FMC** wind model. The wind may be entered at up to four different altitudes.

(13)TAKEOFF/APPROACH KEY (TO/APPR)
(a)TAKEOFF page

**ON A/C ALL

(Ref. Fig. 050)
- Access - TO/APPR key when the aircraft is in the DONE, PREFLIGHT, TAKEOFF phases. If this page is displayed when the flight phase transitions to CLB the page will not automatically change to the APPR page.
- Purpose - Display or modifiy necessary takeoff parameters.
- Data Fields
  1L - V1 - Input by pilot for reference purposes. This parameter is output on the EFIS bus for display on the PFD.
  2L - VR - Input by the pilot for reference. Comes on from the FCU.
  3L - V2 - Displayed here for pilot reference. Comes on from the FCU. This value is locked in when the flight phase transitions from PREFLIGHT to TAKEOFF or CLB.
  4L - FLP RETR - Flap Retraction Speed. This value is calculated by the FMC but may be changed by the pilot. It is always displayed in large front
  5L - SLT RETR- Slat Retraction Speed. This value is calculated by the FMC but may be changed by the pilot. It is always displayed in large font
  6L - VFTO - Final Takeoff Velocity. This value is calculated by the FMC but may be changed by the pilot. It is always displayed in large font.
  1R - TO SHIFT - The Takeoff shift function may be activated here. The data field and associated label lines remain blank and will reject entries until an origin runway is defined. Upon runway definition the prompt is displayed with SELECT* in the data line (Ref. Fig. 050). The pilot may then activate the Takeoff shift function for use in position initialization by pressing the LS key. Then ACTIVE is displayed instead of SELECT*. If reverts to SELECT* if the field is cleared or if a F-PLN revision redefines the origin runway. The selected origin runway is displayed in columns 11-13. If an origin runway has not been defined dashes will be displayed.
  2R - THR RED - Thrust Reduction Altitude.
  3R - ACCEL - Acceleration Altitude.
  4R - EO ACCEL - Engine Out acceleration altitude.
  5R - EO THR RED - ENG OUT thrust-reduction altitude.
  6R - APPR - Allows access to the APPR page. This prompt is only displayed if there is a primary destination in the active F-PLN.
  2R - 5R - These fields display dashes until either the default values are calculated or a pilot entry is made. The pilot may enter these values at anytime in Preflight, and once the pilot has entered the value, the FMC will not change the entered value to the default value unless the field is cleared.





BM5 34 63 00 0 BPMO

TAKEOFF
Figure 050

(b)APPR page
(Ref. Fig. 051)

**ON A/C 001-100, 105-200,

Post SB 34-2109 For A/C 105-200,

Post SB 34-2120 For A/C 001-100,

(Ref. Fig. 052)

R **ON A/C 101-200,

R Post SB 34-2109 For A/C 101-200,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 053)

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

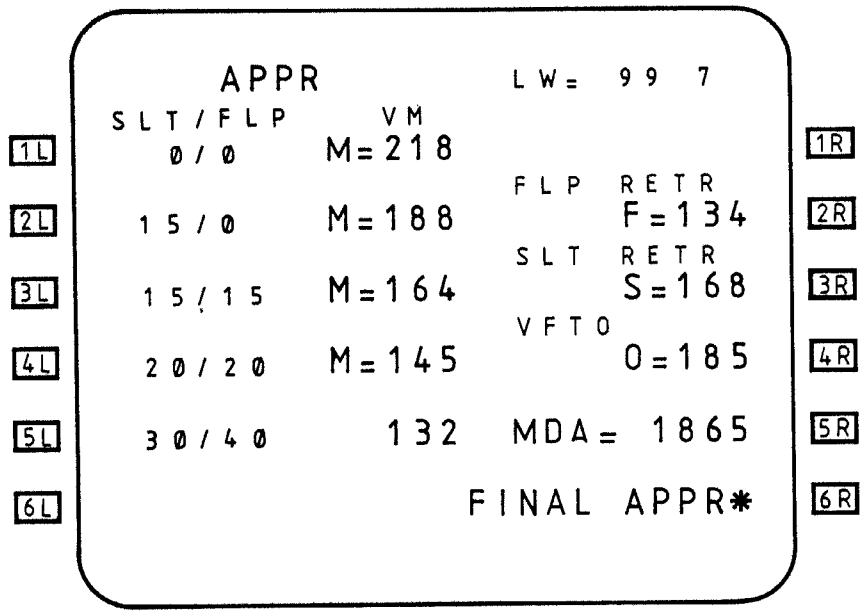
R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 054)

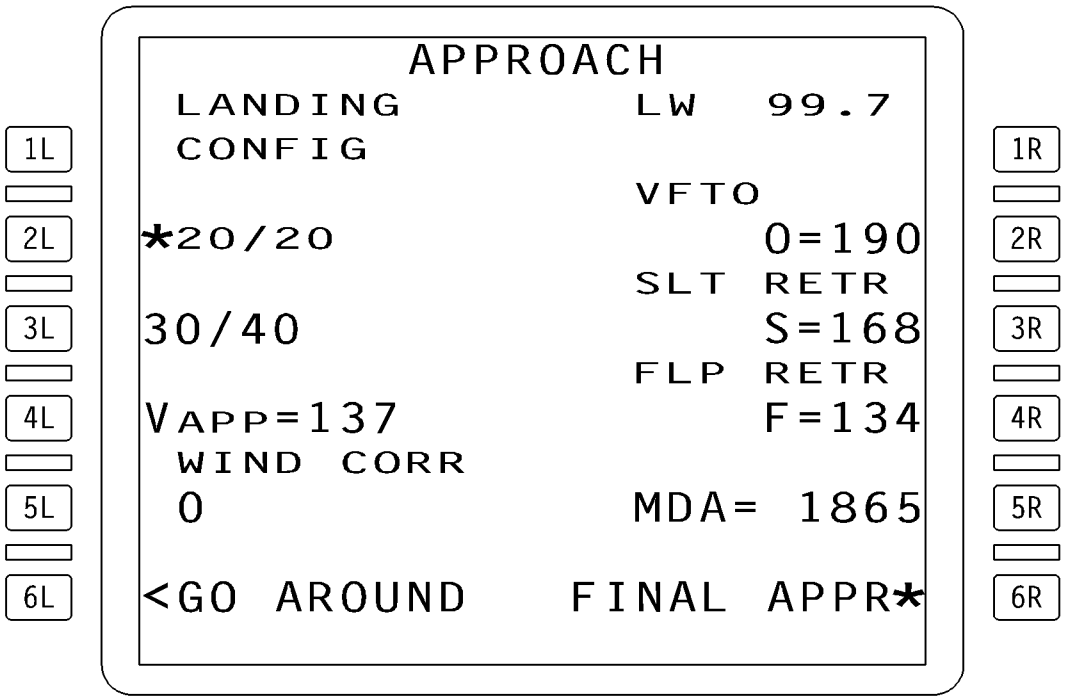
**ON A/C ALL

- Access - TO/APPR key when if the aircraft is in the CLB, CRZ, DES, or APPR phase of the flight and there is a primary destination in the active F-PLN.
  LS key from TAKEOFF page
  If there is not a primary destination and the TO/APPR key is pressed during the CLB, CRZ, DES or APPR flight phases, message "NOT ALLOWED" will be displayed and the APPR page will not be



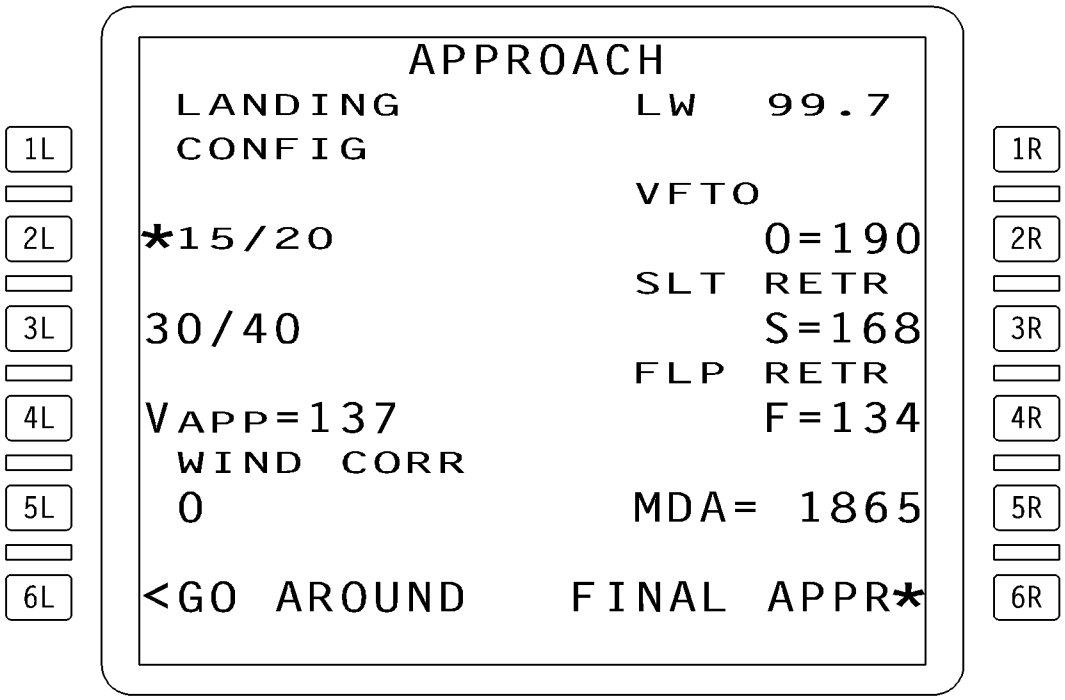
BM5 34 63 00 0 BQMO

APPROACH
Figure 051



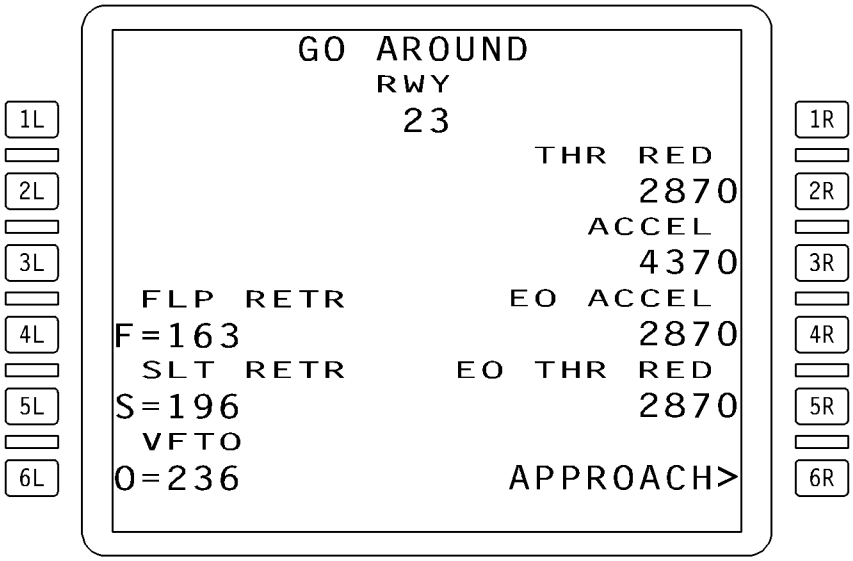
BM5 34 63 00 0 FEM0 00

APPROACH
Figure 052



BM5 34 63 00 0 FNM0 00

APPROACH
Figure 053



BM5 34 63 00 0 FFM0 00

GO AROUND
Figure 054

displayed.

- Purpose - Display pertinent approach data for display during the approach phase of the flight.
- Data Fields

Title - The predicted landing weight is displayed, right justified, in columns 19 through 23.

1L-5L - For each SLT/FLT setting the maneuvering speed is displayed. in large font.

The calculation of these speeds is defined as a function of the FLAP/SLAT position. The values of the FLAP/SLAT indicated on the CDU (see table 9 below) are the same as the values indicated on the FLAP/SLAT position lever.

TABLE 9

CDU SLT/FLT DISPLAY
0/0
15/0
15/15
15/20
30/40

2R - 3R - FLP RETR and SLT RETR. These values are calculated by the FMC but may be changed by the pilot. They are always displayed in large font.

4R - VFTO - Final take off velocity. This value is calculated by the FMC but may be changed by the pilot. It is always displayed in large font.

5R - MDA - Minimum Descent Altitude. This field is blank except as follows. When the A/C is in the descent or approach phase MDA is displayed in columns 16-19 and, if no MDA has been entered, brackets are displayed in columns 21-24. The pilot may enter the MDA when the brackets are displayed and may change the value if it had previously been entered.

6R - After the MDA is entered in 5R, FINAL APPR* will be displayed in this field. Pressing 6R confirms the MDA and causes the FINAL APPR prompt to disappear. At this point the MDA output to the EFIS is declared valid and the displayed value is transmitted. If the value of the MDA is subsequently changed by the pilot the output to the EFIS is declared invalid and the FINAL APPR prompt is again displayed. The new value will not be transmitted to the EFIS as a valid MDA until 6R is again pressed.

(14)REFERENCE KEY (REF)

R **ON A/C 101-200,

R Post SB 34-2151 For A/C 101-200,

R - Access - TO/APPR key when if the aircraft is in the CLB, CRZ, DES, or
R APPR phase of the flight and there is a primary destination in the
R active F-PLN.
R LS key from TAKEOFF page
R If there is not a primary destination and the TO/APPR key is
R pressed during the CLB, CRZ, DES or APPR flight phases, message
R "NOT ALLOWED" will be displayed and the APPR page will not be
R displayed.
R - Purpose - Display pertinent approach data for display during the
R approach phase of the flight.
R - Data Fields
R Title - The predicted landing weight is displayed, right justified,
R in columns 19 through 23.
R 1L-5L - For each SLT/FLP setting the maneuvering speed is displayed.
R in large font.
R The calculation of these speeds is defined as a function of the
R FLAP/SLAT position. The values of the FLAP/SLAT indicated on the CDU
R (see table 9 below) are the same as the values indicated on the FLAP/
R SLAT position lever.

R TABLE 9

CDU SLT/FLP DISPLAY
0/0
15/0
15/15
15/20
30/40

R 2R - VFTO - Final take off velocity. This value is calculated by the
R FMC but may be changed by the pilot. It is always displayed in large
R font.
R 3R - 4R - FLP RETR and SLT RETR. These values are calculated by the
R FMC but may be changed by the pilot. They are always displayed in
R large font.
R 5R - MDA - Minimum Descent Altitude. This field is blank except as
R follows. When the A/C is in the descent or approach phase MDA is
R displayed in columns 16-19 and, if no MDA has been entered, brackets
R are displayed in columns 21-24. The pilot may enter the MDA when the
R brackets are displayed and may change the value if it had previously
R been entered.
R 6R - After the MDA is entered in 5R, FINAL APPR* will be displayed
R in this field. Pressing 6R confirms the MDA and causes the FINAL
R APPR prompt to disappear. At this point the MDA output to the EFIS

R is declared valid and the displayed value is transmitted. If the
R value of the **MDA** is subsequently changed by the pilot the output
R to the **EFIS** is declared invalid and the **FINAL APPR** prompt is
R again displayed. The new value will not be transmitted to the
R **EFIS** as a valid **MDA** until **6R** is again pressed.

R (14)REFERENCE KEY (REF)

R **ON A/C ALL

(Ref. Fig. 055)

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 056)

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

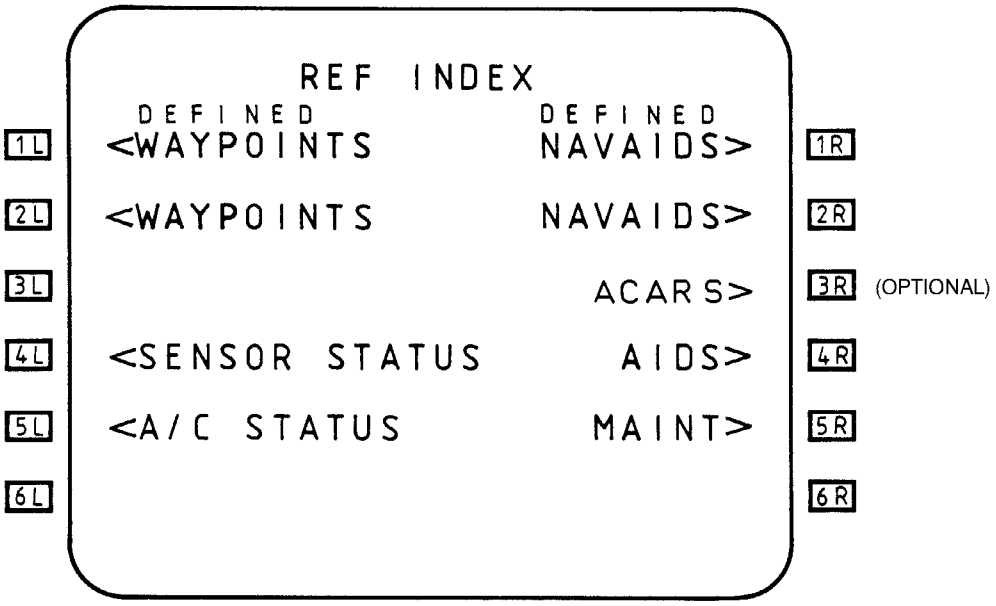
R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 057)

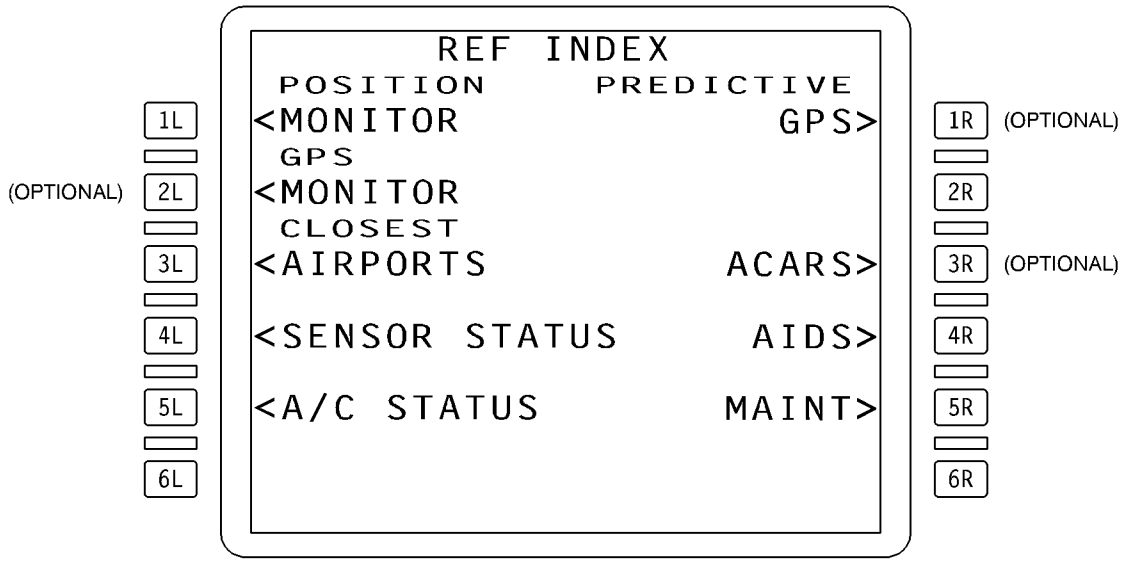
**ON A/C ALL

(a)REF INDEX page
- Access - REF key on CDU face
- Purpose - Allows access to various reference pages
- Data Fields
  Pressing LS keys allows access to the associated reference page. See specific pages for accesses.
  5R - MAINT - This prompt is only displayed when in the DONE or PREFLIGHT phase. Pressing this LS key changes the CDU display to the MAINT page.



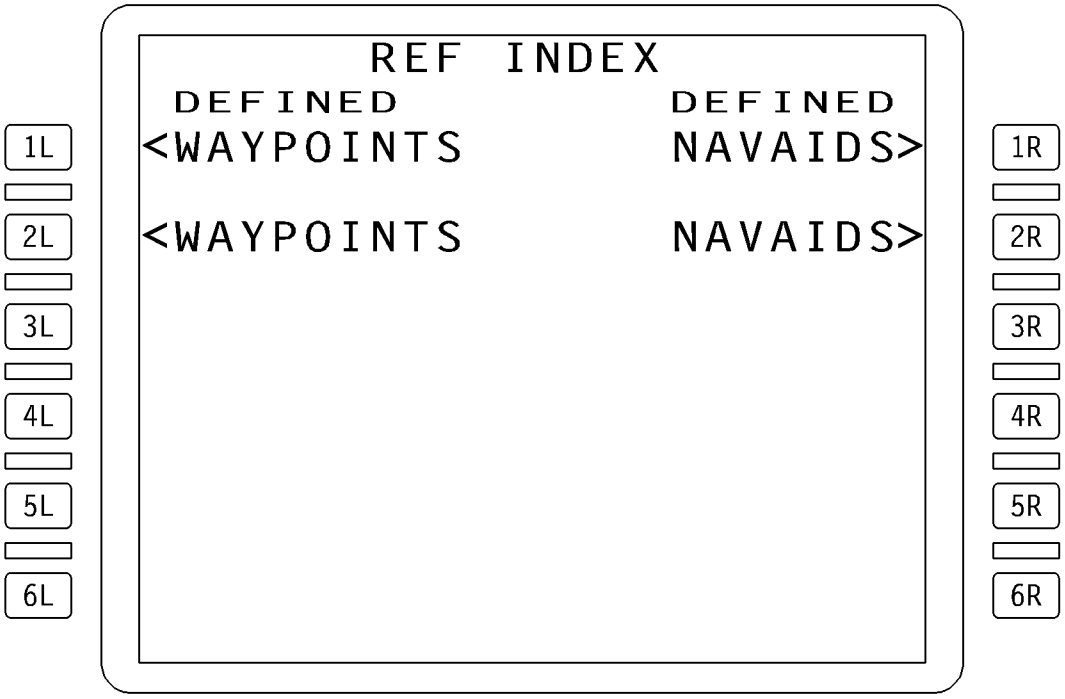
BM5 34 63 00 0 BNV0 01

REF INDEX Page
Figure 055



BM5 34 63 00 0 FGM0 00

REF INDEX Page Sheet 1/2
Figure 056



BM5 34 63 00 0 FHM0 00

REF INDEX Page Sheet 2/2
Figure 057

(b)NAVAID page

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(a)REF INDEX pages
- Access - There are two REF INDEX pages. The REF key provides access to the REF INDEX page 1, the NEXT PAGE key allows switching between REF INDEX pages 1 and 2.
- Purpose - Allow access to the POSITION MONITOR, PREDICTIVE GPS, GPS MONITOR, CLOSEST AIRPORTS, ACARS, SENSOR STATUS, AIDS, A/C STATUS, MAINT, WAYPOINTS and NAVAIDS pages.
- Data Fields
  The data fields feature prompts to provide access to the corresponding page by pressing the adjacent LS key.
  The PREDICTIVE GPS and GPS MONITOR prompts are available only if the GPS option is active. The ACARS prompt is available only if the ACARS option is active. The MAINT prompt is displayed only in DONE or PREFLIGHT flight phase.

(b)POSITION MONITOR page

This page is available even without the GPS option.
- Access - LS Key from REF INDEX page 1 (REF Key).
- Purpose - Displays general navigation information.
- Data Fields
  Title - POSITION MONITOR or POSITION FROZEN AT HHMM.
  1L/1R - FMC1 position and navigation mode (see below)
  2L/2R - FMC2 position and navigation mode (see below)
  3L/3R - Depending on navigation mode, either onside FMC "RADIO" or "GPS" or "GPIRS" position or dashes can be displayed
  4L/4R - Onside FMC "MIX IRS" position is displayed (weighted average of 3 IRS positions, or IRS own/3/opp position by order of priority in case of single or double IRS failure).
  5L/5R - Status of each IRS (INVAL, ALIGN, NAV or ATT) along with the distance between each IRS and onside FMC position.
  6L - FREEZE/UNFREEZE toggle prompt allows to freeze/unfreeze the data displayed on this page (upon access to the page the data is not frozen).
  6R - DESELECT GPS/SELECT GPS toggle prompt is available only if

the GPS option is active. GPS is selected by default on ground to compute FMC position ; once the DESELECT GPS LS key is pressed, GPS remains ignored by the FMC until the next flight or until the SELECT GPS LS key is pressed.

Navigation mode can be one of the following :
nIRS/GPS : GPS position is used to compute onside FMC position (available only with the GPS option).
nIRS/GPS/LOC : idem with LOC updating
nIRS/DME/DME : RADIO position used to compute onside FMC position is determined from the distances to 2 DME beacons
nIRS/DME/LOC : idem with LOC updating
nIRS/VOR/DME : RADIO position used to compute onside FMC position is determined from the distance and bearing to a "co-located" VOR/DME beacon pair
nIRS/VOR/LOC : idem with LOC updating
nIRS : IRS - only navigation
nIRS/LOC : idem with LOC updating
"n" is the number of IRS used to compute "MIX IRS" position (3 or 1 in case of single or double IRS failure).
LOC updating uses localizer signals to shift FMC position so that it lies on the LOC axis.

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 058)

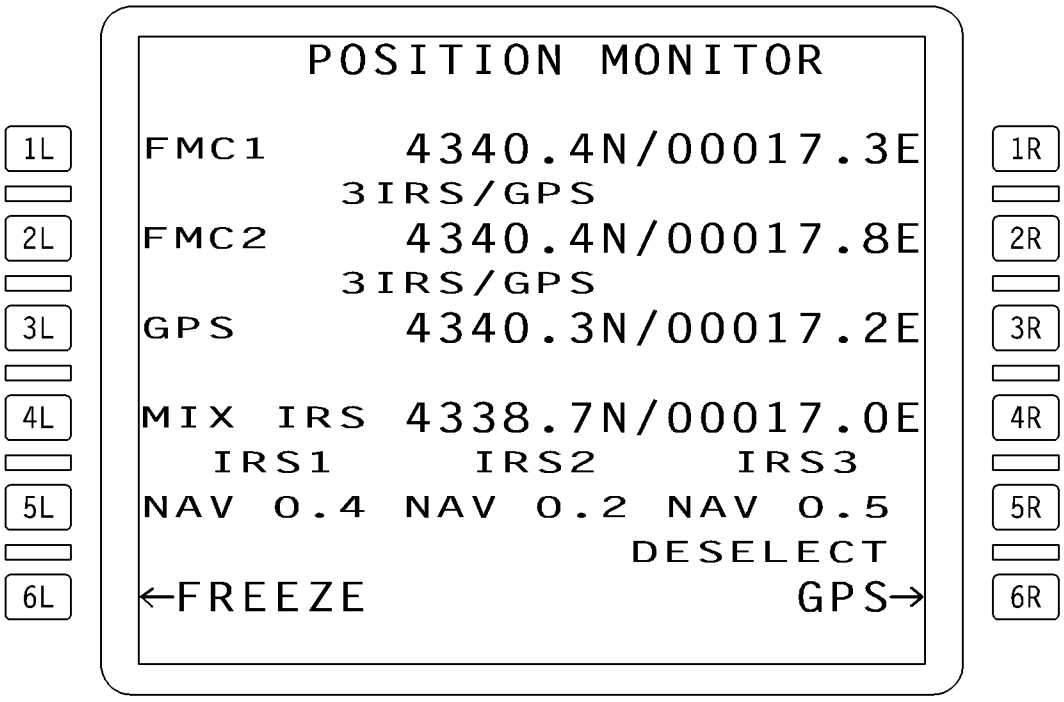
**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,



NOTE : IF GPS FUNCTION ACTIVATED IN FMS

BM5 34 63 00 0 FJM0 00

POSITION MONITOR Page
Figure 058

(c)CLOSEST AIRPORTS page
- Access - LS Key from REF INDEX page 1 (REF Key).
- Purpose - Displays the 5 airports in the navigation database that are closest to and within 2000 NM of the current aircraft position.
- Data Fields
  Title - CLOSEST AIRPORTS
  1L-5L - the ICAO identifiers of up to 5 closest airports are displayed in order of increasing distance from the current aircraft position.
  Bearing and distance from the current aircraft position to each airport are displayed on the respective line.
  Only airports that are between 2 and 2000NM from the current aircraft position are displayed.
  If there are no such airports in the navigation database, "NONE WITHIN 2000 NM" is displayed.
  If aircraft position is invalid, "CHECK A/C POSITION" is displayed.
  6R - RETURN allows return to the REF INDEX 1 page.

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 059)

**ON A/C ALL

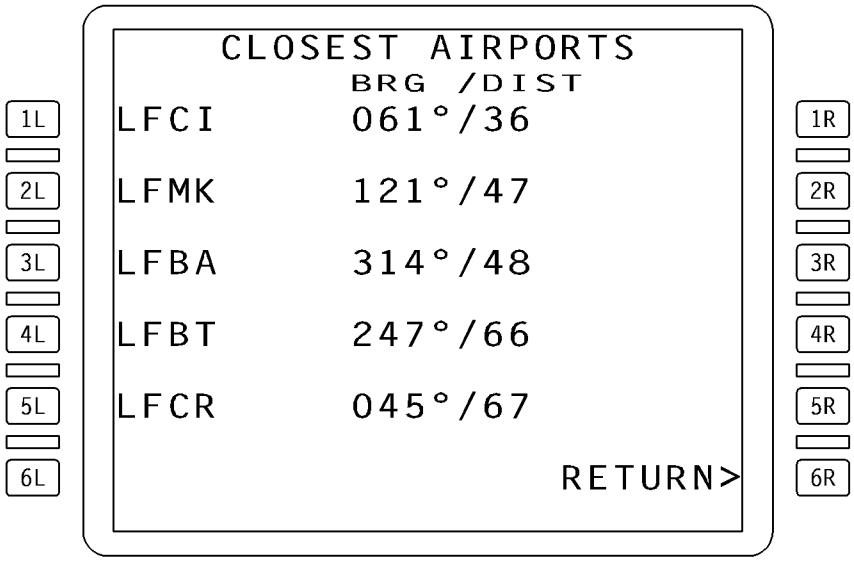
Post SB 34-2109 For A/C 101-200,

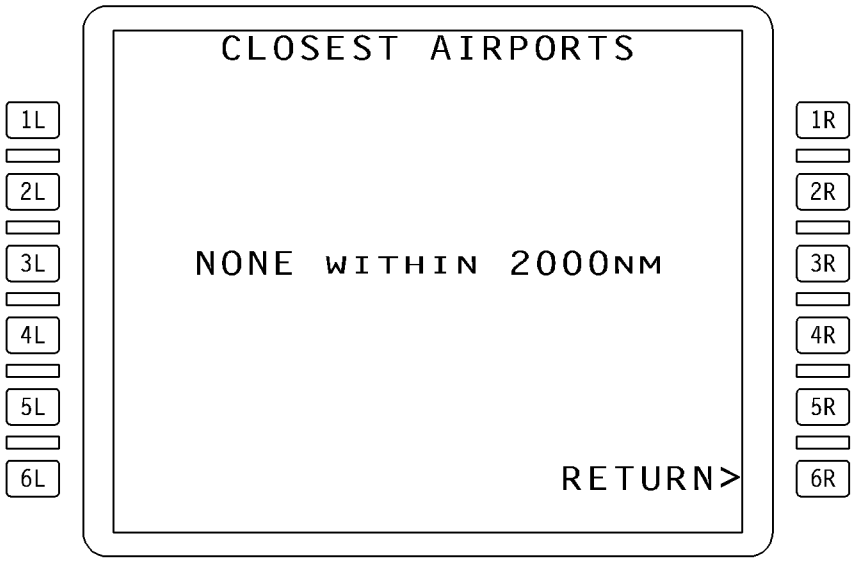
Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(d)GPS MONITOR page





BM5 34 63 00 0 FKM0 00

CLOSEST AIRPORTS Page
Figure 059

This page is available only with the GPS option.
- Access - LS Key on REF INDEX page Sheet 1 (REF key).
- Purpose - Displays information directly from the GPS receiver.
- Data Fields
  Title - GPS MONITOR
  1L/IR - GPS 1 position
  2L/2R - GPS 1 true track, altitude and ground speed.
  True track is determined by derivating the GPS position ; it is unavailable on ground (dashed).
  Altitude is geodesic referenced to the surface of the WGS84 ellipsoid earth mode 1. Ground speed is computed based on GPS carrier signal Doppler shift and is available even on ground.
  3L/3R - GPS 1 Figure of merit, mode and number of satellites being tracked. The merit is the estimated "confidence circle" centered on aircraft GPS position within which the actual aircraft position is believed to be (by the GPS receiver).
  Mode is the GPS receiver operating mode and can be either :
  INIT - system initialization is too fast for this display to be seen.
  ACQ - the GPS receiver is in the process of acquiring satellites to compute a position.
  This happens after power up or during the flight if satellites are lost due to degraded signal-to-noise ratio.
  NAV - normal operating mode throughout the flight.
  TEST - not applicable.
  FAULT - GPS receiver self - detected failure.
  ALT AID - degraded position using 3 satellites and baro altitude (GPS PRIMARY is not possible in this mode).
  AIDED - GPS receiver "dead reckoning" degraded mode : position output is NCD and not used by the FMC.
  DIFF - provision for differential GPS operation.
  4L/4R - GPS 2 latitude and longitude
  5L/5R - GPS 2 true track, altitude and ground speed
  6L/6R - GPS 2 figure of merit, mode and number of satellites being tracked.

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 060)

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

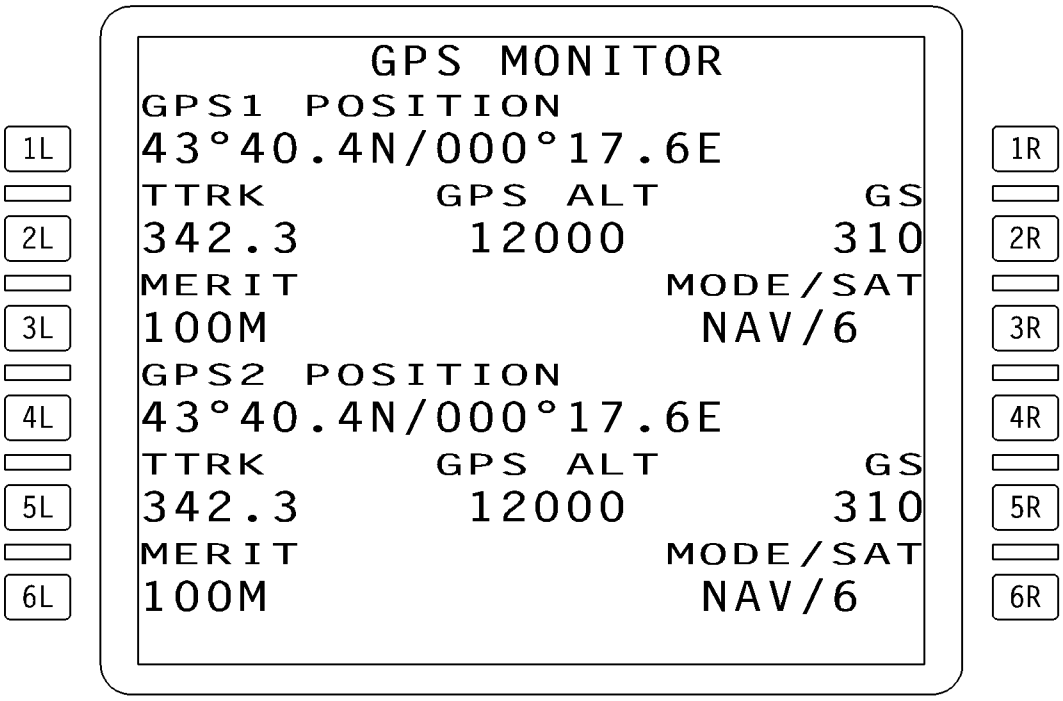
R Post SB 34-2151 For A/C 101-200,

(2)PREDICTIVE GPS page
This page is available only with the GPS option with RAIM (Receiver Autonomous Integrity Monitoring).
- Access - LS key on REF INDEX page 1 (REF key)
- Purpose Displays the predicted availability of RAIM at destination during estimated time of arrival ± 15 mn and at any single pilot-entered waypoint over a pilot-defined ± 15 mn time period.
- Data Fields
  1L/1R - Destination ICAO identifier and destination ETA (Estimated Time of Arrival). Both can be modified by the crew.
  2L/2R - Predicted RAIM availability at destination over ETA ± 15 mn time period at 5 mn time intervals. Y indicates RAIM is predicted to be available with APPROACH AREA integrity, N otherwise.
  3L/3R - Pilot-entered waypoint identifier and corresponding ETA (at the waypoint).
  4L/4R - Predicted RAIM availability for the pilot-defined waypoint.
  5L, 5R, 6L, 6R - Identification numbers of satellites deselected for the predictive RAIM function. Up to 4 entries can be made.
  Deselections can be cleared or remain effective until the next flight.
  There is no effect on actual real-time position computation.

**ON A/C ALL

Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,



NOTE : IF GPS FUNCTION ACTIVATED IN FMS

BM5 34 63 00 0 FLM0 00

GPS MONITOR Page
Figure 060

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

(Ref. Fig. 061)

**ON A/C ALL

(Ref. Fig. 062)
- Access - LS key from REF INDEX page
  DELETE ALL LS keys from DEFINED NAVAID page.

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- Access - LS key from REF INDEX page 2.
  DELETE ALL LS keys from DEFINED NAVAID page.

**ON A/C ALL

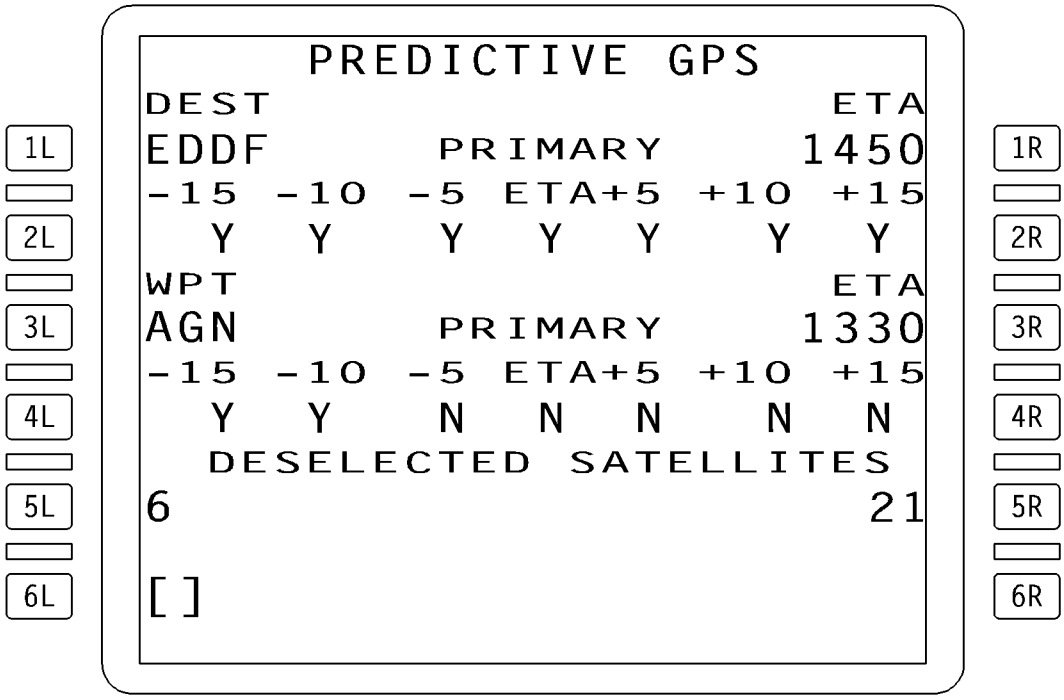
Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

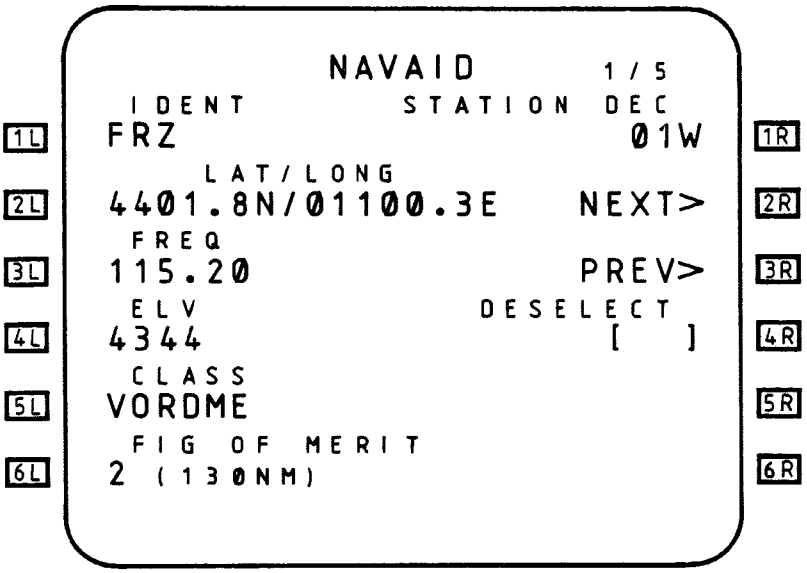
- Purpose - Displays information pertaining to navaids being tuned by the FMC or any navaid in the data base and allows flight crew to deselect navaids that are in the data base.
- Data Fields
  Title - These are navaids automatically tuned by the FMC. There may be from 1 to 5 tuned at a time. The 1/5 in the top right (columns 21 - 23) indicates that the first one out of five is being dis-

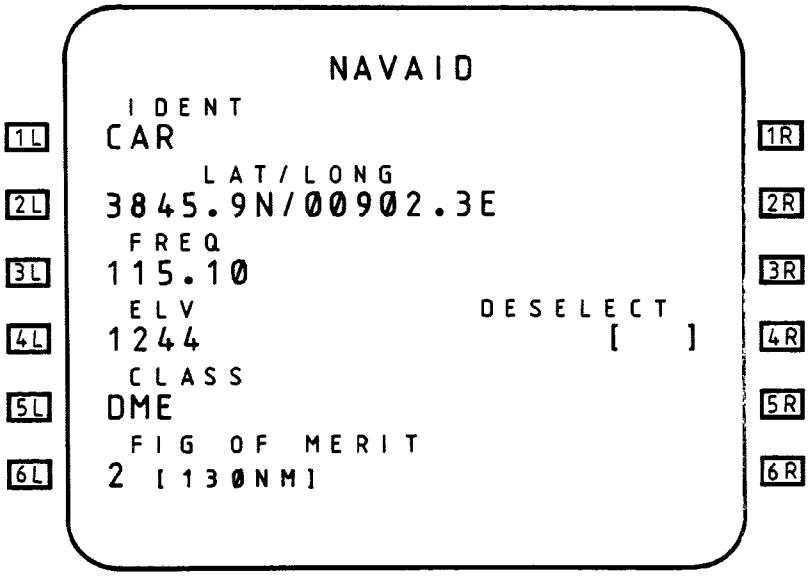


NOTE: IF GPS FUNCTION ACTIVATED IN FMS

BM5 34 63 00 0 FMM0 00

PREDICTIVE GPS Page
Figure 061





BM5 34 63 00 0 BSMO

Navaid Autotuned or Not
Figure 062

played. If the pilot inserts a navaid IDENT in 1L, this field will be blank.
1L - IDENT - Navaid identifier. The navaids being tuned by the FMC are displayed automatically upon each access to this page. All tuned navaids may be referenced by using the NEXT-PREV LS keys. However, any navaid in the data base may be referenced by typing in the navaid IDENT. Once an IDENT is entered via the scratchpad, the tuned stations can no longer be accessed by NEXT/PREV LS keys. If there are no tuned navaids, four boxes will be displayed.
2L - LAT/LONG of navaid. If a non-collocated VOR DME is displayed, the LAT/LONG is the VOR LAT/LONG.
3L - FREQ - Frequency of navaid (6 fields NNN.NN)
4L - ELV - Elevation of navaid. in feet to the nearest 10 feet. If the navaid is a non-collocated VOR DME, the elevation is the elevation of the DME. If a VOR only is displayed the elevation field will be blank
5L - CLASS - The class of navaid is displayed and may be any of the following :

VOR	ILSDME
DME	VORTAC
LOC	VORDME
ILS	

If the navaid is a non-collocated VOR DME, the word NON-COLLOCATED will be displayed in columns 8 through 21.
6L - FIG of MERIT - A figure assigned to each navaid indicating the maximum distance at which it can be tuned. The distance is displayed in parentheses following the figure of merit.
0 - 40 NM
1 - 70 NM
2 - 130 NM
3 - 250 NM

A figure of merit does not exist for LOC or ILS so this field is blank when these class of NAV AID are displayed
1R - STATION DEC - The station declination of the navaid. Displayed only if the navaid is a VOR, VORTAC, or VORDME (Ref. Fig. 062)
2R - NEXT - Advances display to the next NAVAID page. This is displayed only prior to entering an IDENT into 1L.
3R - PREV - Changes the page to the previous NAVAID page. This is displayed only prior to entering at IDENT into 1L.
The navaid pages are closed loop.
The list contains all the navaids that are presently selected for tuning. The NAV AID selected for display on the PROG page and RMI is displayed on the first page. If an ILS DME is being tuned, it is displayed on the last page. If in MANUAL tuning, the station being manually tuned is the only one displayed.
4R - DESELECT - IDENT of deselected navaid is displayed. The pilot may deselect a navaid by entering the navaid IDENT into this field. Deselection results in that navaid not being tuned or used for navigation by the FMC. Only one station may be deselected at a time. Deselection of a second station will allow the FMC to use the first station deselected. Clearing the deselected navaid (using CLR function) allows the FMC to again use that navaid. This field is cleared upon transition to the DONE or PREFLIGHT phase or when the second data base is activated on the A/C STATUS page.

(c)DEFINED NAVAID page

**ON A/C ALL

(Ref. Fig. 063)
- Access - LS key from REF INDEX page if there is at least one navaid defined by the pilot.

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- Access - LS key from REF INDEX page 2 if there is at least one navaid defined by the pilot.

**ON A/C ALL

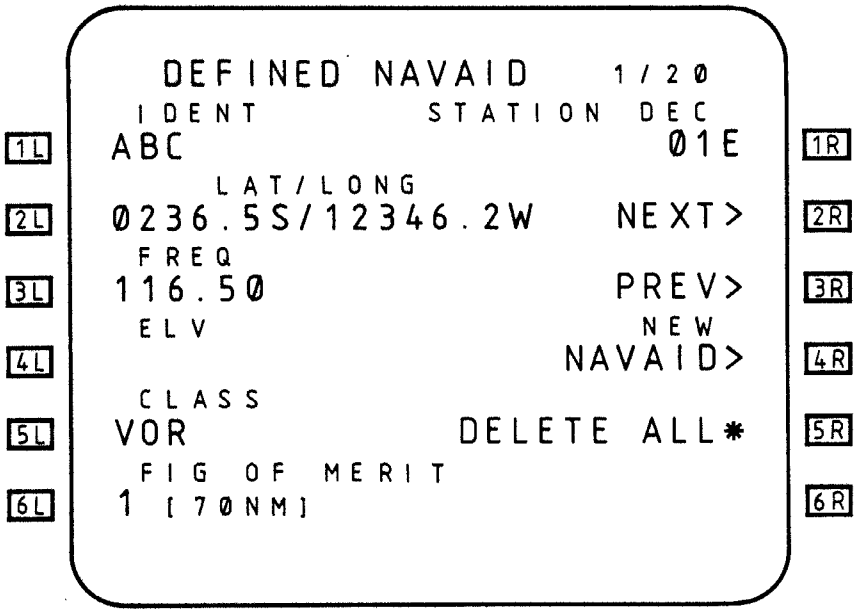
Post SB 34-2109 For A/C 101-200,

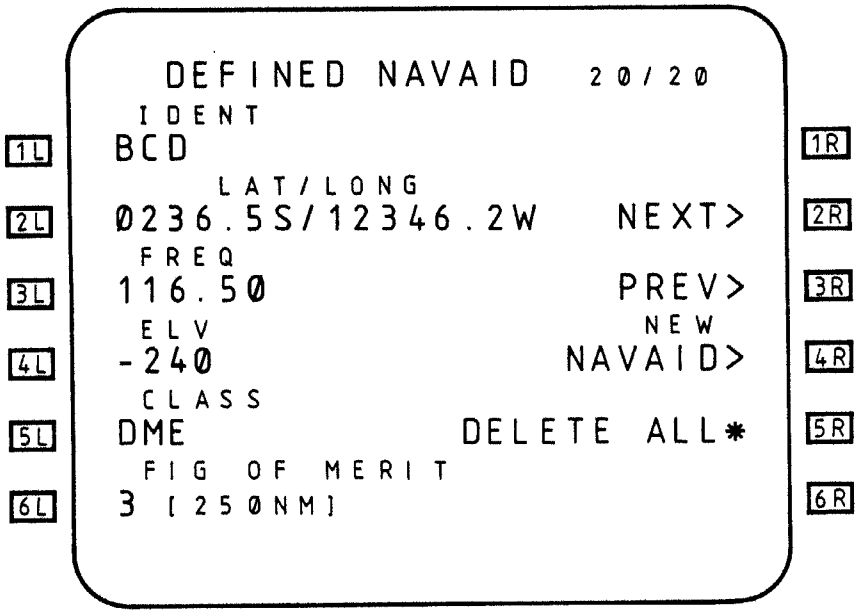
Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

Insertion of navaid on NEW NAVAID page.
- Purpose - Allows the flight crew to view the flight crew defined navaids, access the NEW NAVAID page in order to define a navaid, and delete from the defined navaids list the navaid being displayed.
- Data Fields
Title - In the upper right corner (1/20 in the figure) it is indicated how many navaids have been defined by the pilot (columns 22 - 23, left justified) and which one is being displayed (columns 19 - 20, right justified). The first and last of 20 are displayed in figures.
1L-6L - Same as NAVAID page, only non-collocated VOR/DME will not be displayed.





BM5 34 63 00 0 BTMO

Defined Navaids
Figure 063

1R - STATION DEC - When the navaid is a VOR, VORTAC, or VORDME, its station declination is displayed here.
Otherwise, this field is blank.
2R NEXT - Changes display to the next DEFINED NAVAID page. The first defined navaid follows the last defined navaid.
3R - PREV - Changes display to the previous DEFINED NAVAID page. The last defined navaid is the previous one from the first defined navaid.
4R - NEW NAVAIDS - Allows access to the NEW NAVAID page to define a navaid.
5R - DELETE ALL - Deletes all defined navaids from the DEFINED NAVAIDS list. The page changes to the NAVAID page. If any of the defined navaids are waypoints in the flight plan, or are being used for either position computation or display on the PROG page, they are not deleted. Message "F-PLN WPT/NAV RETAINED" will be displayed, and the display stays on the DEFINED NAVAID page 1/X displayed.
1L - Clearing the IDENT field deletes this navaid from the DEFINED NAVAIDS list. If only one is defined and it is deleted, the display goes to the NAVAID page. If two or more are defined, display the DEFINED NAVAID page with the NEXT navaid displayed.
If the NAVAID being cleared is a waypoint in the flight plan, or is being used for either position computation or display on the PROG page, deletion is not allowed and message "F-PLN WPT/NAV RETAINED" is displayed.

(d)NEW NAVAID page

**ON A/C ALL

(Ref. Fig. 064)
- Access - LS key from DEFINED NAVAID page.
  DEFINED NAVAID LS key from REF INDEX page if there are no defined navaids.

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

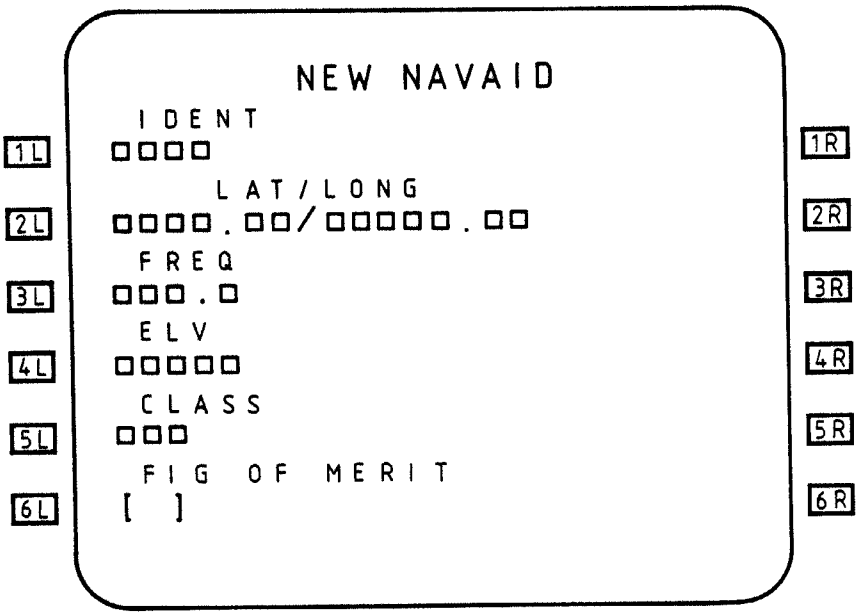
R Post SB 34-2142 For A/C 101-104,

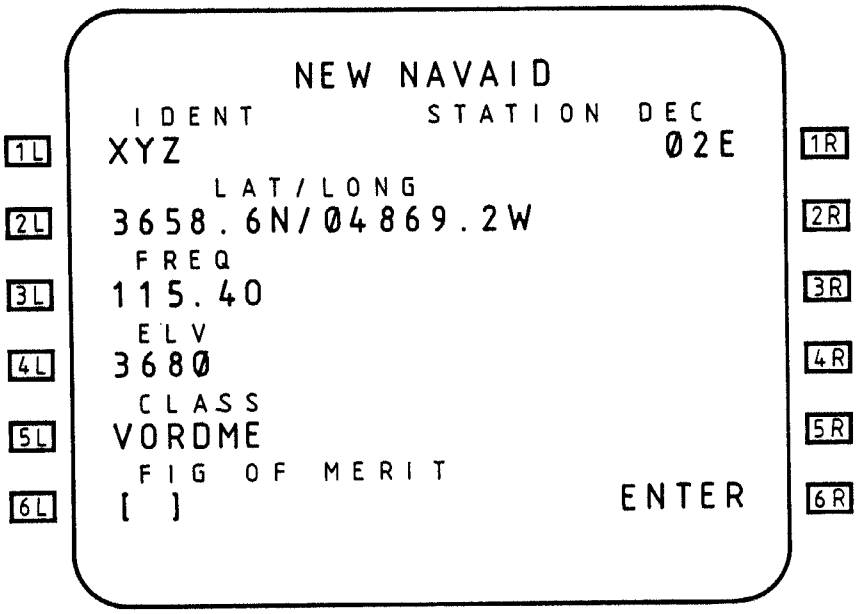
R Post SB 34-2151 For A/C 101-200,

- Access - LS key from DEFINED NAVAID page.
  DEFINED NAVAID LS key from REF INDEX page 2 if there are no defined navaids.

**ON A/C ALL

- Purpose - Define a new navaid to the FMC. Up to 20 navaids may be defined by the flight crew. This becomes part of the data base.
- Data Fields
  1L - IDENT - Enter the station identifier. This IDENT may be duplicate identifier.
  2L - LAT/LONG - Enter the LAT/LONG of the navaid.
  3L - FREQ - Enter the frequency of the navaid
  4L - ELV - Enter the elevation of the navaid. If the data is VOR only, entry of ELV is not necessary to allow insertion. ELV is displayed to the nearest 10 feet.
  5L - CLASS - The crew must enter the class of the navaid as follows:
  VOR = VOR only
  DME = DME or TACAN
  VORDME = collocated VOR/DME ILSDME = collocated ILS and DME
  VORTAC = collocated VOR and TACAN
  LOC = localizer
  6L - FIG of MERIT - Enter the figure of merit for the navaid. If nothing is entered, two is assumed when INSERT LS key is pressed. A figure of merit does not exist for LOC, so this field is blank in this case.
  1R - STATION DEC - The station declination must be entered if the prompt is displayed. This prompt is displayed if VOR, VORTAC, or





BM5 34 63 00 0 BUMO

New Navaid
Figure 064

VORDME is entered into 5L.
6R - ENTER - When 1L-5L and 1R are complete, this prompt is displayed. This LS key must be pressed to store the navaid for use by the FMC. Upon insertion, the display changes to the DEFINED NAVAID page with this navaid displayed. If the page is left without ENTER being pressed, then the navaid data is deleted. If there are already 20 navaids defined, one must be deleted to make room for the one being inserted.
The first one defined (1/20) is deleted (if not a flight plan waypoint) and the remaining defined navaids are moved up (2/20 becomes 1/20, etc). The newly inserted navaid becomes 20/20. If 1/20 was a flight plan waypoint, try to delete 2/20, etc. If all defined navaids are flight plan waypoints, do not allow insertion and display message "LIST OF TWENTY IN USE".
After the navaid is inserted it may also be used as a waypoint on the flight plan page.

(e)WAYPOINT page
(Ref. Fig. 065)
- Access - LS key on REF INDEX page.
DELETE ALL LS key on DEFINED WAYPOINTS page.

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

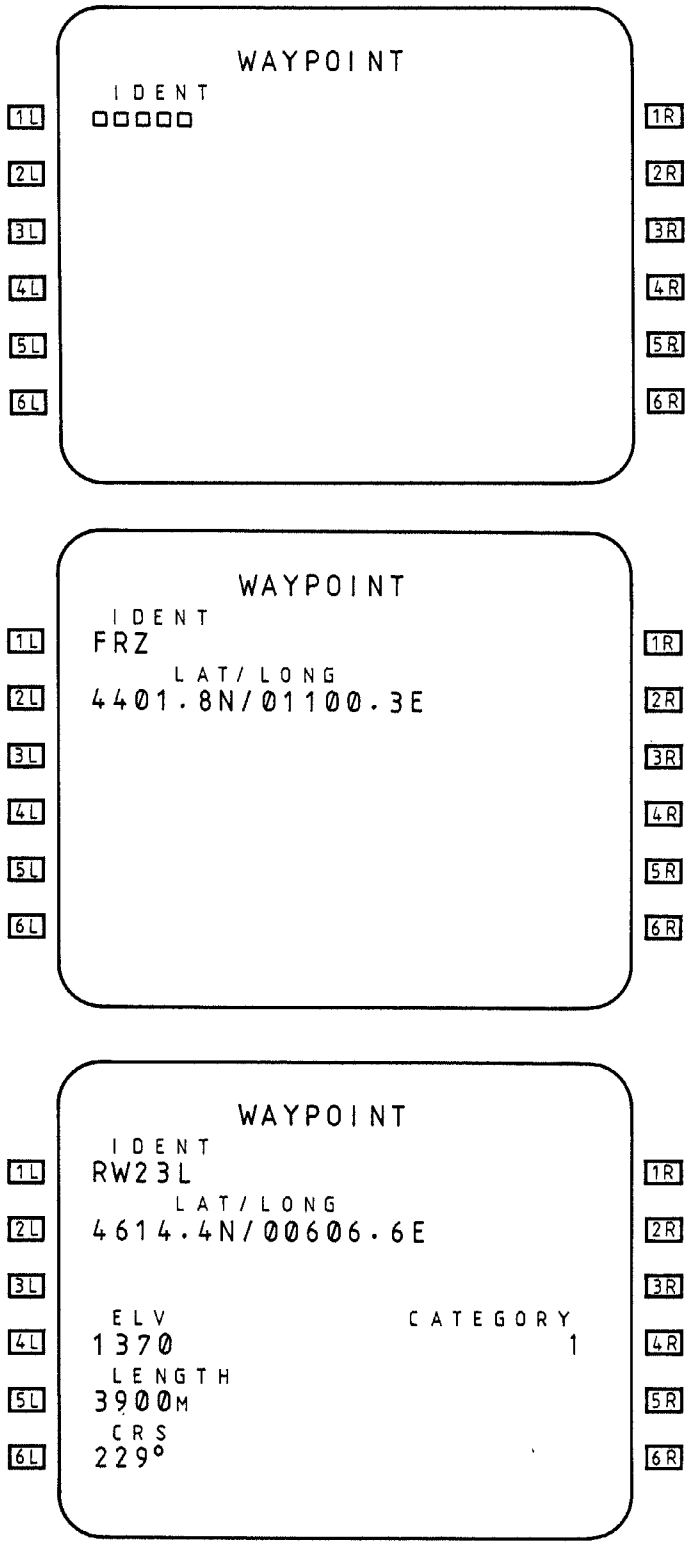
R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- Access - LS key on REF INDEX page 2.
DELETE ALL LS key on DEFINED WAYPOINTS page.

**ON A/C ALL

- Purpose - To display pertinent information about waypoints contained in the data base.
- Data Fields
1L - WAYPOINT IDENTIFIER - May be any data base waypoint, navaid, ARPT, or runway. The pilot must enter the waypoint IDENT into this field. For a runway, the pilot must input ARPTNN where NN is the runway number and ARPT is the ICAO airport identifier. The NN must be followed by L or R or C if there is more than one runway with the same NN.
2L - LAT/LONG - LAT/LONG of the waypoint.
3L - A waypoint may be defined as a PLACE/BRG/DIST. If the waypoint is defined this way, the PLACE/BRG/DIST will be displayed here in columns 1-18. (Ref. Fig. 066)
4L - ELV - If the waypoint is a runway, the runway elevation is displayed here in feet to the nearest 10 feet. Columns 1-5 are used.
5L - LENGTH - If the waypoint is a runway, the length is displayed here. Length is displayed in columns 1-4 and in column 5, M is displayed in small font to indicate meter.
6L - CRS - If the waypoint is a runway, the course will be displayed here in columns 1-3.
4R - CATEGORY - If the waypoint is a runway with an ILS approach the category (0, 1, 2 or 3) of the approach is displayed here.



Waypoint
Figure 065

(f)DEFINED WAYPOINT page
(Ref. Fig. 066)
- Access - LS key on REF INDEX page when at least one waypoint has been defined.

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

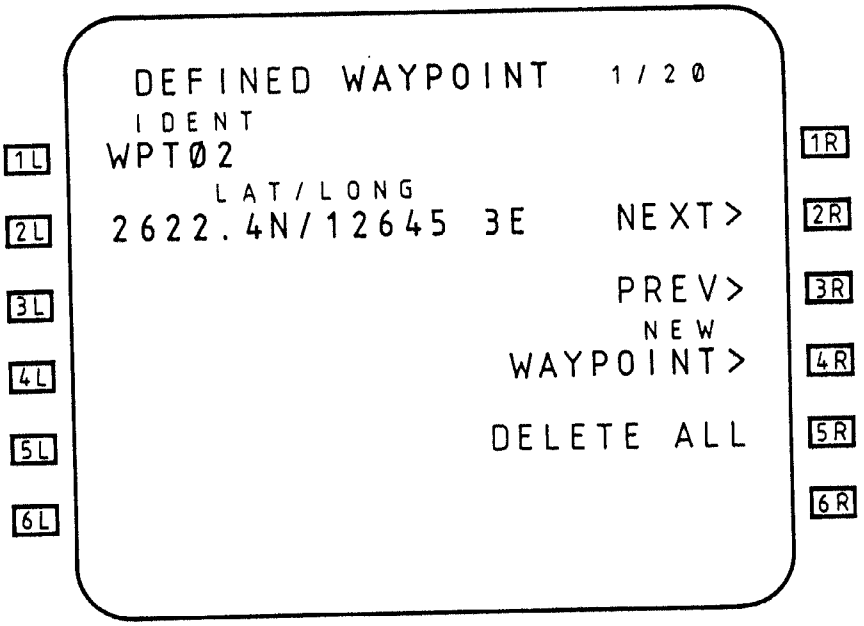
R Post SB 34-2142 For A/C 101-104,

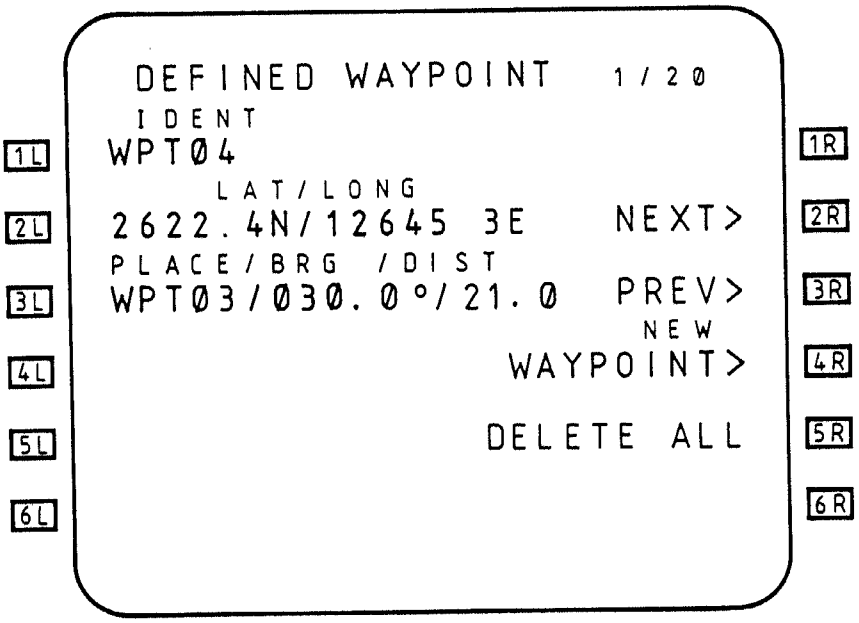
R Post SB 34-2151 For A/C 101-200,

- Access - LS key on REF INDEX page 2 when at least one waypoint has been defined.

**ON A/C ALL

- Insertion of a new waypoint on NEW WAYPOINT page.
- Purpose - Display and/or delete waypoints defined by the flight crew.
- Data Fields
  Title - In the upper right corner (1/20) indicates how many waypoints have been defined by the pilot (in columns 22-23, left justified) and which one is displayed (columns 19-20, right justified). Here there are 20 defined and the fit one defined is displayed.
  1L, 2L, 4L, 5L, 6L - These fields are the same as in the WAYPOINT page.
  3L - A waypoint may be defined as a PLACE/BRG/DIST. If the waypoint is defined this way, the PLACE/BRG/DIST will be displayed here in columns 1-18.
  2R - NEXT - Changes the display to the next DEFINED WAYPOINT page. The first defined waypoint follows the last defined waypoint.
  3R - PREV - Changes the display to the previous DEFINED WAYPOINT page. If the first defined waypoint is displayed and this line select key is pressed, the last defined waypoint will be displayed.
  4R - NEW WAYPOINT - Allows access to the NEW WAYPOINT page.
  5R - DELETE ALL - Deletes all waypoints previously defined by the pilot. The display changes to the WAYPOINT page. If any of the DEF WAYPOINTS are waypoints within the flight plan, they are not deleted, message "F-PLN WPT/NAV RETAINED" will be displayed, and the display remains on the DEFINED WAYPOINTS page with 1/X displayed. The displayed waypoint will be deleted from the defined waypoints if the 1L field is cleared. If only one is defined and it is deleted, the display goes to the WAYPOINT page. If two or more are defined,





8M5 34 63 00 0 BWMO

Defined Waypoints
Figure 066

the **DEFINED WAYPOINT** page with the **NEXT** waypoint is displayed. If the **WAYPOINT** being cleared is a waypoint in the flight plan, deletion is not allowed and message "**F-PLN WPT/NAV RETAINED**" is displayed.

(g)NEW WAYPOINT page
(Ref. Fig. 067)
- Access - LS key on DEFINED WAYPOINT page.
DEFINED WAYPOINT LS key on REF INDEX if there are no defined waypoints.

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

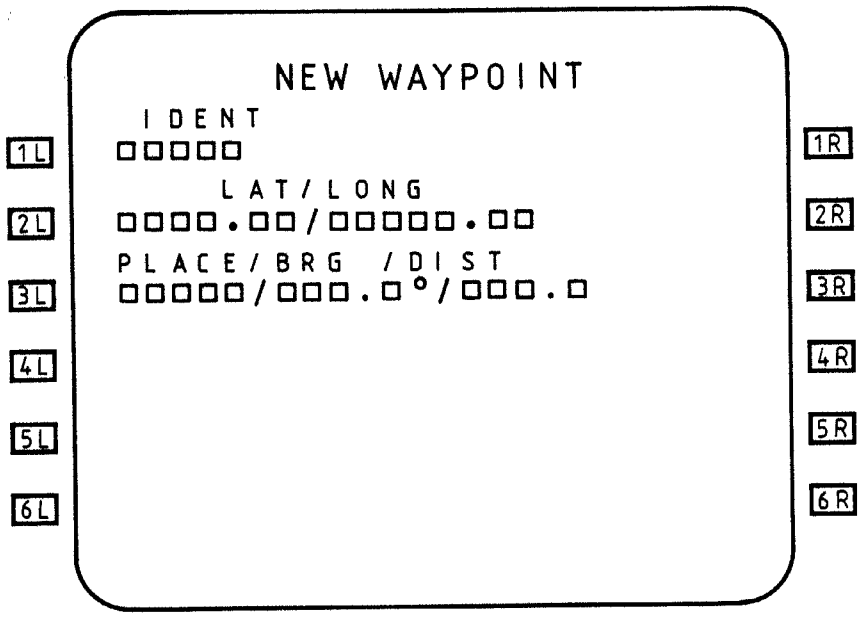
R Post SB 34-2142 For A/C 101-104,

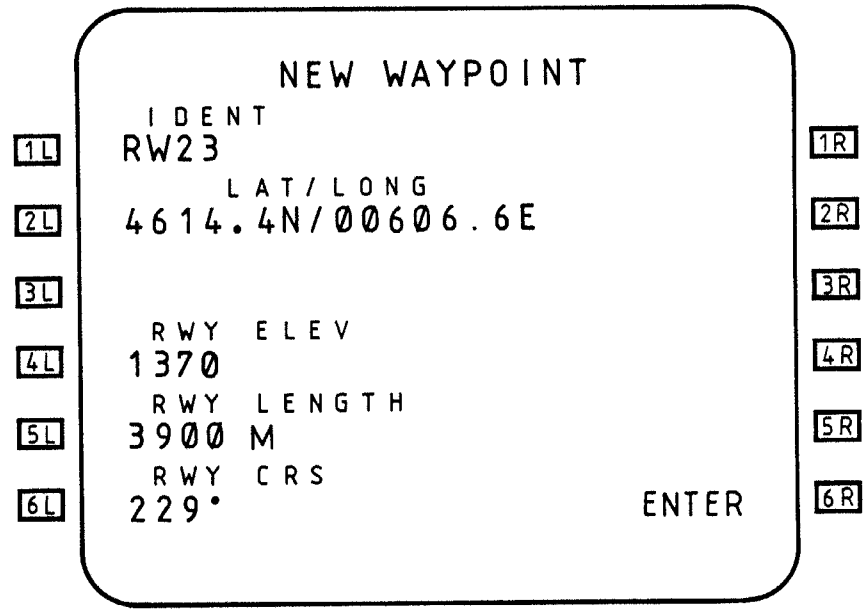
R Post SB 34-2151 For A/C 101-200,

- Access - LS key on DEFINED WAYPOINT page.
DEFINED WAYPOINT LS key on REF INDEX page 2 if there are no defined waypoints.

**ON A/C ALL

- Purpose - Define a new waypoint to the FMC. Up to 20 waypoints may be defined by the flight crew. If a waypoint is entered (by LAT/LONG or PLACE/BRG/DIST) directly on the flight plan page, it is included as one of these twenty with the abbreviated identifier. Although a terminal/en route designation is not entered via the data fields all defined waypoints are classified as both terminal and en route for EFIS display.
- Data Fields
1L - IDENT - The waypoint identifier must be entered here. The IDENT may be the same as already in the data base. A runway may be denoted by using RWNN (where NN is any number 0-36) as the fit four characters of the identifier.
2L - LAT/LONG - If the waypoint is defined as a LAT/LONG, the LAT/LONG must be entered here.
3L - PLACE/BRG/DIST - If the waypoint is defined as a PLACE/BRG/DIST, the PLACE/BRG/DIST must be entered here.
If the LAT/LONG is entered in 2L, line 3L prompts will be blanked. If 3L is entered, the LAT/LONG will be displayed in 2L.
4L, 5L, 6L - If the waypoint identifier is a runway, then these prompts will appear. Otherwise, they are blank. The runway elevation, course, and length must be entered on these lines. ELV is displayed to the nearest 10 feet. When these fields are displayed, an M will be displayed in small font in column 5 of line 5L.
6R - ENTER - This prompt is displayed when the IDENT field and 2L or 3L have been entered. However, if the IDENT is a runway, 4L, 5L,





BMG 34 63 00 0 BXMO

New Waypoint
Figure 067

and 6L must also be entered before this prompt is displayed. This LS key must be pressed to insert the waypoint into the FMC. The page changes to the **DEFINED WAYPOINT** page with the newly-inserted waypoint being displayed. If the page is left without **ENTER** being pressed, then the waypoint data is deleted.
If there are already 20 waypoints defined, one must be deleted to make room for the one being inserted. The first one defined (1/20) is deleted (if not a waypoint in the flight plan) and the remaining defined waypoints are moved up (2/20 becomes 1/20, etc). The newly inserted waypoint becomes 20/20. If 1/20 was a waypoint in the flight plan, try deleting 2/20, etc. If all defined waypoints are waypoints in the flight plan, do not allow the insertion and display message **"LIST OF TWENTY IN USE"**. If the defined waypoint is a runway it may be used as an origin or destination, but there will not be any **SID**s or **STAR**s available for the airport. The **LAT/LONG** or **PLACE/BRG/DIST** entered in 2L or 3L will be assumed to be at the runway threshold point if the waypoint is a runway.

(h)SENSOR STATUS page
(Ref. Fig. 068)
- Access - LS key on REF INDEX page

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

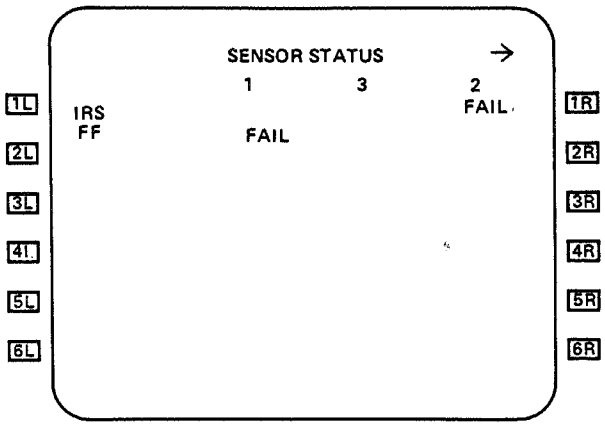
R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

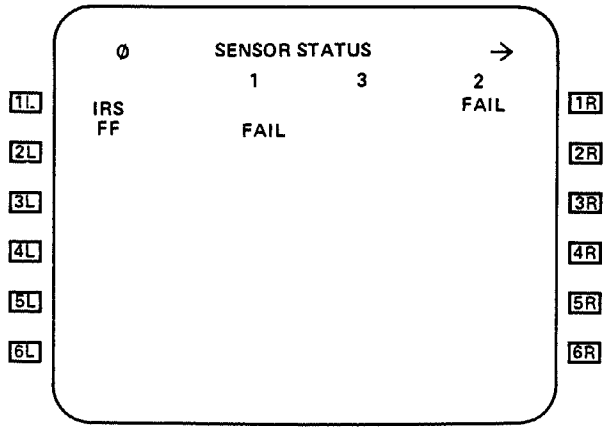
- Access - LS key on REF INDEX page 1.

**ON A/C ALL

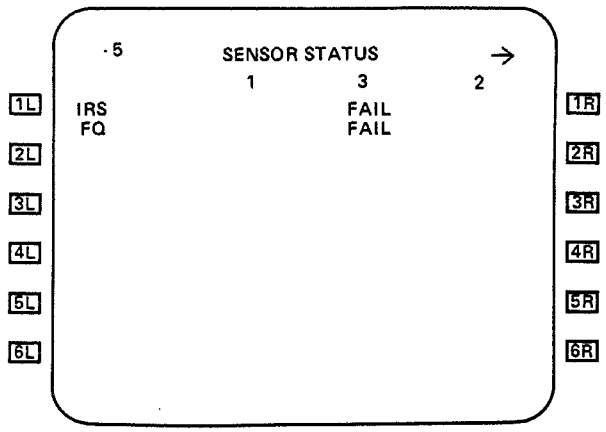
- Purpose - Displays information on the status of the devices that provide sensor inputs to the FMC
- Data Fields
  The status of each sensor for the current flight leg and the previous six flight legs in which a failure occurred is recorded and may be viewed on the SENSOR STATUS pages. Only the failed sensors will be displayed. Up to 11 lines may be used to display failed sensors. Vertical slewing is not used.
  Title - For previous flight legs the flight leg counter is displayed in columns 2-4. For the current flight leg this field is blank.
  The NEXT PAGE key is used to display all the flights. Each press of the NEXT PAGE key advances the page to the earlier flight in which a failure occurred.
  The following sensors may be listed as failed.
  In addition FMC is displayed for FMC hardware failures and FMCSW for FMC software exception failures. (1 = left side of aircraft, 2 = right side of aircraft, 3 = center.)
  VOR - 1, 2
  DME - 1, 2
  ILS - 1 or 2 (whichever is on side)
  ADC - 1, 2
  IRS - 1, 2, 3
  FCU - 3
  TCC - 1, 2
  FF - 1, 2
  FQ - 3
  CLOCK - 1, 2
  EFIS CP - 1 or 2 (whichever is on side)
  FAC - 1, 2



SENSOR STATUS PAGE (CURRENT FLIGHT LEG)



SENSOR STATUS PAGE (PREVIOUS FLIGHT LEG)



SENSOR STATUS PAGE (6TH PREVIOUS FLIGHT LEG)

BM5 34 63 00 0 BYMO 14 09
DM5

SENSOR STATUS Page
Figure 068

(1) FMC - 1 or 2 (whichever is on side)
(1) FMCSW - 1 or 2 (whichever is on side)
CDU - 1 or 2 (whichever is on side)
DIS-IN - for FMC 1 or 2 (whichever is on side)
NOTE : (1) not displayed for current flight leg.
Where only one sensor is fitted to the A/C (FCU, FQ) then failures of these senso are indicated In column 3.
If the SENSOR STATUS page for the current flight leg is accessed while the system is in the Independent mode of operation, then message "INDEPENDENT OPERATION" is displayed in the scratchpad.
The message is automatically cleared on leaving the SENSOR STATUS page for the current flight leg.

(i)A/C STATUS page
(Ref. Fig. 069)
- Access - LS key from REF INDEX
Automatic display upon long term power up.
Automatic display after landing when fuel flow is lower than 200kg/h.

**ON A/C 101-104,

Post SB 34-2142 For A/C 101-104,

Post SB 34-2109 For A/C 101-104,

- Access - LS key from REF INDEX
Automatic display upon long term power up.
Automatic display after landing when fuel flow is lower than 400 pounds/h.

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

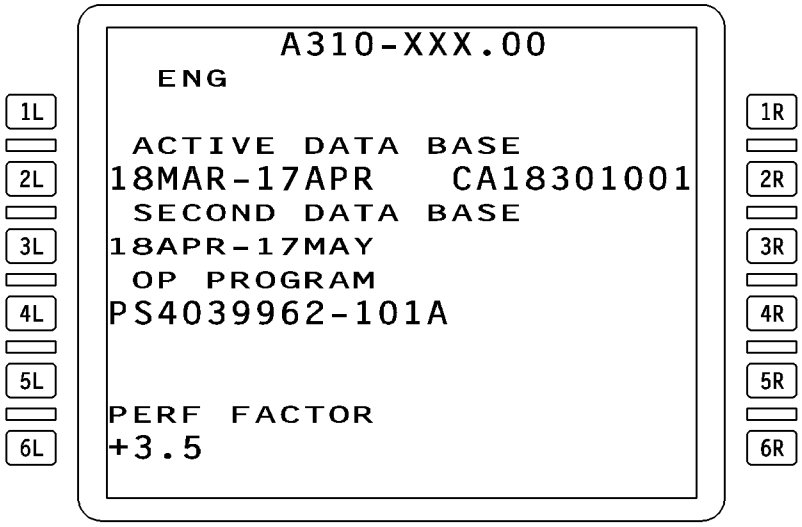
R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- Access - LS key from REF INDEX page 1.
Automatic display upon long term power up.
Automatic display after landing when fuel flow is lower than 200kg/h.

**ON A/C ALL

- Purpose - Allows crew to review the FMC data base and program configuration. Also, the flight crew may activate the second data base.
- Data Fields
Title - The configuration of A/C is displayed in columns 7 through 17. The aircraft model number is the three digit number in columns 12 through 14.
Column 15 always displays a decimal point and the weight variant is the two digit number displayed in columns 16 and 17. The aircraft model number and weight variant are dependent on the state of Program



BM5 34 63 00 0 BZM0 01

A/C STATUS Page
Figure 069

Pins
The first digit of the aircraft model number defines the airframe series and the remaining two digits indicate engine type.
1L - Engine type - Displays the type of engines the aircraft has for prediction purposes. The information displayed is determined by the state of the discretes entitled Engine Manu 1 and Eng Manu 2 and Eng. Type 1, 2 and 3.
- If a configuration failure exists (i.e. wrong FMS pin programming or a wrong P/N FMS), this field displays LATERAL ONLY in columns 1 through 12 in large front.

2L-2R
3L-3R
| Display the data base part number and effectivity for the active and second data base. The data base part number is displayed left justified in colomns 15-24 of line 2L-2R. The effectivity of the active data is displayed in large font in line 2L-2R ; the effectivity of the second data base is displayed in small font in line 3L-3R. In both cases, the effectivity is displayed in columns 1-11. The crew may activate the second data base by pressing LS key 3L. If the second data base is activated the effectivities will switch positions.

The effectivity end date of active data base and the selected cycle are transmitted on the general output bus as NDB Effective End Date.
NOTE :
If the date is provided by the clock (as displayed on the AIDS page) the switching of the data base (as displayed on the aircraft status page) shall be automatic given the following conditions :
- power on after long term power failure (> 10 s), and
- aircraft on ground, and
- no active F-PLN.

4L - The OP program part number is displayed here in columns 1-14, left justified in large font.
6L-PERF FACTOR - This value is calculated by the FMC but may be updated by the pilot. Display is in columns 1-4 in large font.

(j)Maintenance pages
(Ref. Fig. 070)
1 MAINT page
- Access - LS key from REF INDEX page
If the MAINT page is displayed when the flight phase transitions from PREFLIGHT or DONE to TAKE OFF, CLB, CRZ, DES or APPR, the display will change to the F-PLN page A.
- Purpose - Allow maintenance personnel to perform certain test
- Data Fields
1L - SELF TEST - Pressing this LS key initiates the internal self test of the FMC.
2L - ANN TEST - Annunciator test. Pressing this LS key will light all four annunciators on the CDU face and the prompt CANCEL will be displayed in line 2R.
3L - TEST PATTERN - The CDU TEST - TEST PATTERN page will be displayed.
4L - KEY TEST - Pressing this LS key will cause the KEY TEST page to be displayed.

R **ON A/C ALL

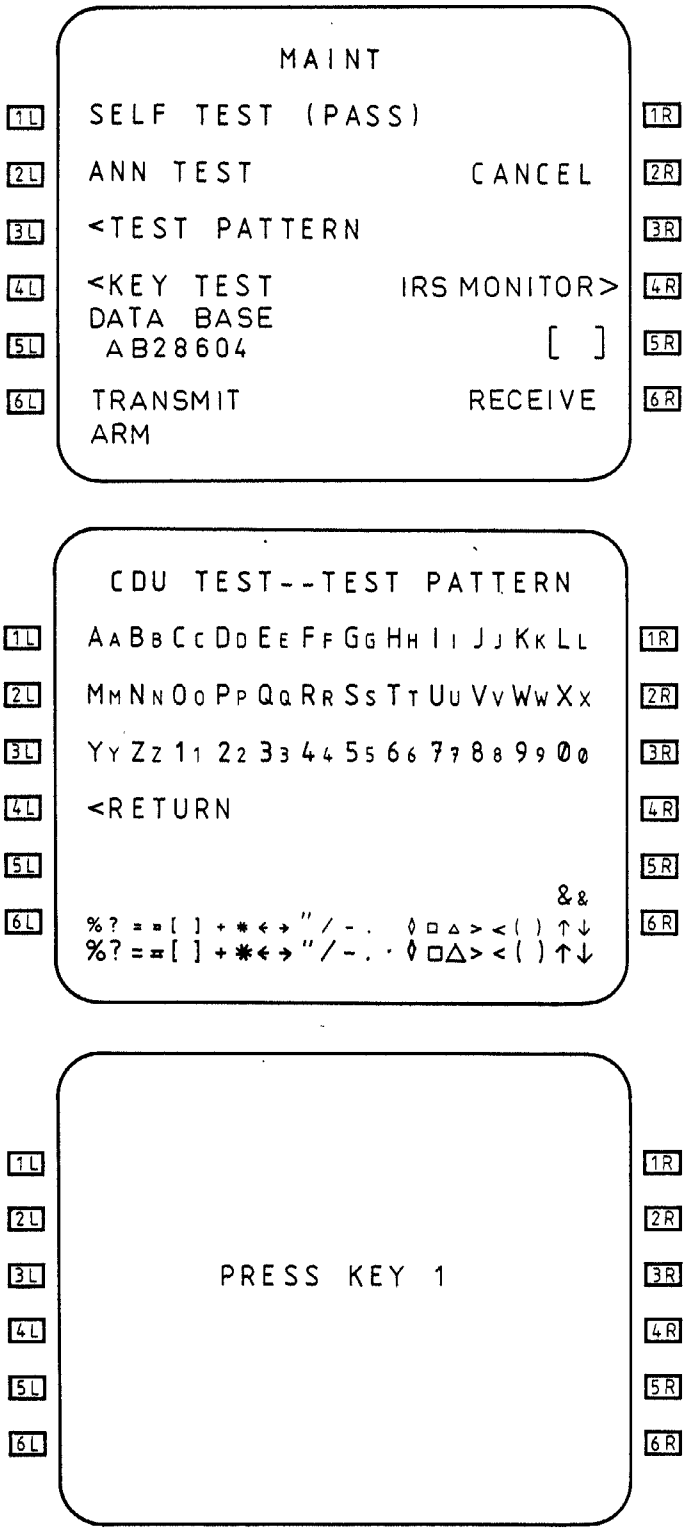
R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

1 MAINT page
- Access - LS key from REF INDEX page 1.
If the MAINT page is displayed when the flight phase transitions from PREFLIGHT or DONE to TAKE OFF, CLB, CRZ, DES or APPR, the display will change to the F-PLN page A.
- Purpose - Allow maintenance personnel to perform certain test
- Data Fields
1L - SELF TEST - Pressing this LS key initiates the internal self test of the FMC.
2L - ANN TEST - Annunciator test. Pressing this LS key will light all four annunciators on the CDU face and the prompt CANCEL will be displayed in line 2R.
3L - TEST PATTERN - The CDU TEST - TEST PATTERN page will be displayed.
4L - KEY TEST - Pressing this LS key will cause the KEY TEST page to be displayed.



BM5 34 63 00 0 LTN0-00

Maintenance
Figure 070

**ON A/C ALL

- NAV-DATA BASE CROSSLOAD (Optional)
  Purpose of this function is to load one AFMS by the navigation data base from the other. Its initiation will be from maintenance page via REF INDEX page (Ref. Fig. 055) accessible in PREFLIGHT or DONE flight phases only.
  Display on maintenance page will be : current NAV data base identifier, TRANSMIT and RECEIVE prompts and ARM prompt.
  Transfer is initiated by arming both CDUs (ARM typed in scratchpad (SP) and pressing 5R key) and setting one CDU to transmit and the other to receive.
  If an error occurs during transfer, then a scratchpad message "Transfer aborted" is displayed and the NAV data base is set invalid.
  A successful transfer causes "Transfer complete" to be displayed.

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- NAV-DATA BASE CROSSLOAD (Optional)
  Purpose of this function is to load one AFMS by the navigation data base from the other. Its initiation will be from maintenance page via REF INDEX page 1 (Ref. Fig. 056) accessible in PREFLIGHT or DONE flight phases only.
  Display on maintenance page will be : current NAV data base identifier, TRANSMIT and RECEIVE prompts and ARM prompt.
  Transfer is initiated by arming both CDUs (ARM typed in scratchpad (SP) and pressing 5R key) and setting one CDU to transmit and the other to receive.
  If an error occurs during transfer, then a scratchpad message "Transfer aborted" is displayed and the NAV data base is set invalid.
  A successful transfer causes "Transfer complete" to be displayed.
  NOTE : It is not possible to crossload the FMS operational program (if GPS function is activated).

**ON A/C ALL

(k)AIDS pages
(Ref. Fig. 071)
- Access - LS key on REF INDEX page

R **ON A/C ALL

R Post SB 34-2109 For A/C 101-200,

Post SB 34-2120 For A/C 001-100,

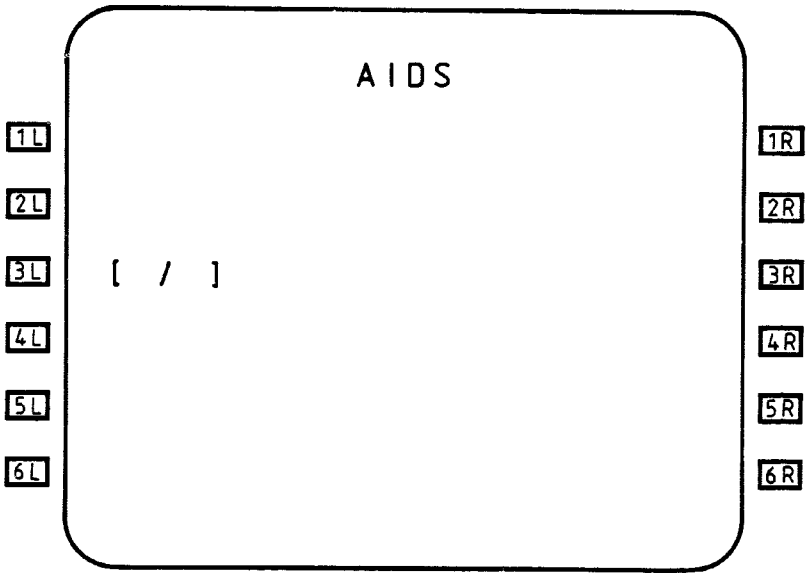
R Post SB 34-2142 For A/C 101-104,

R Post SB 34-2151 For A/C 101-200,

- Access - LS key on REF INDEX page 1.

**ON A/C ALL

- Purpose - Allows flight crew to enter data into the AIDS system through the scratchpad.
- Data Fields
  3L - DAY/MONTH - If the date transmitted by the clock is valid, then it is the default value for this field. Otherwise, the field defaults to boxes. In either case, a pilot entry of DAY/MONTH replaces the default value - clearing the field reverts the display to the appropriate default. Leading zeros are displayed on both day and month. If a date is displayed on this page, then it is also transmitted on the general ouput bus.
  5L - AIDS DATA - Entry into this field causes the entered data to be transmitted on the general output bus as Documentary Data. The entry remains displayed and can be updated by a subsequent entry.



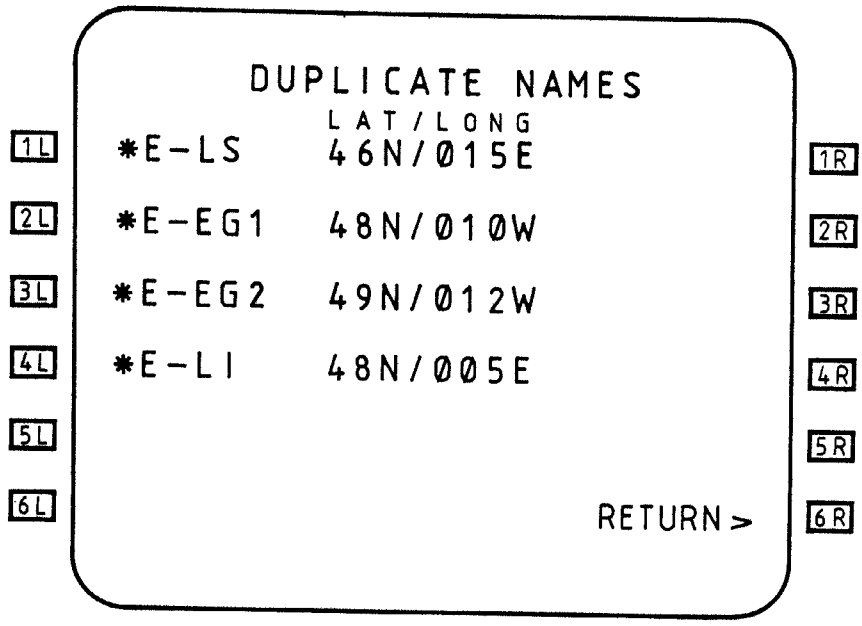
BM5 34 63 00 0 CBMO

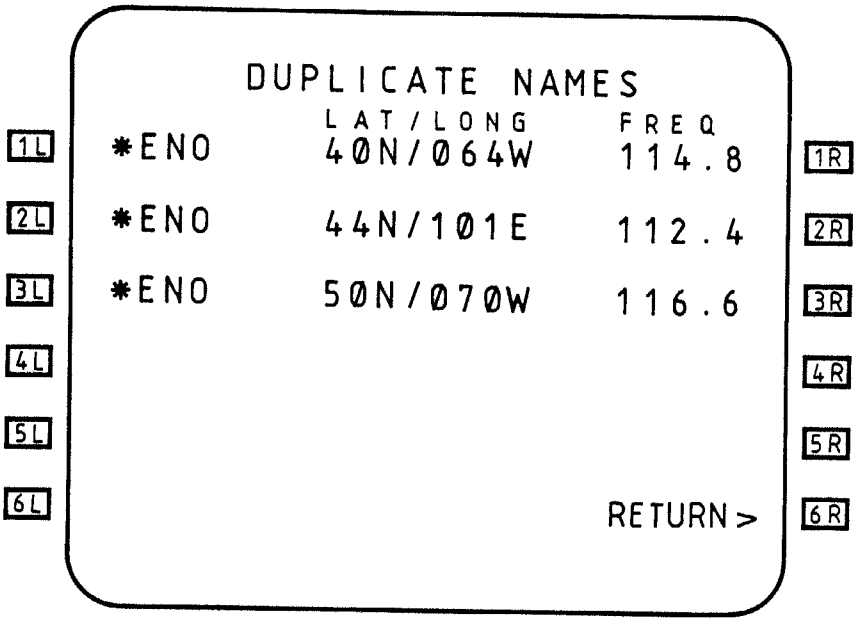
AIDS
Figure 071

(l)DUPLICATE NAMES page
(Ref. Fig. 072)
- Access - A non unique identifier is entered through the CDU on any of the following data fields :

Page	Line Select Key
F-PLN A	(any left LS key)
F-PLN B	(any left LS key)
LAT REV	(4L or 5R)
SEC F-PLN A	(any left LS key)
SEC F-PLN B	(any left LS key)
PROG	(4L, 6L, 6R, 3R)
NAVAID	(1L, 4R)
WAYPOINT	(1L)
DIR TO	(1L)

If access to the DUPLICATE NAMES page was through entry of a non unique identifier on the DIRTO page and the aircraft position becomes invalid, the display will revert to the F-PLN page A.
- Purpose - Allows the flight crew to select a specific waypoint, ARPT, runway or navaid when more than one, with the same identifier, exists in the data base at the time the selection is made.
- Data Fields
  1L-5L - The LAT/LONG of the waypoint or navaid is displayed for the pilot's choice in whole degrees in columns 9-16. Pressing the adjacent LS key selects that point as the entered waypoint or navaid. The display changes to the previously displayed page when the LS key is pressed
  1R-5R - If the entered identifier is entered as a navaid the navaid frequency is displayed in columns 19-24.
  6R - RETURN - Pressing this LS key returns the CDU display to the page which had previously been displayed. No selection is made from among the duplicate entries and the scratchpad is cleared.
  The list of identifiers displayed on the DUPLICATE NAMES Page will automatically decrease if any of the duplicate entries are deleted. The pilot must still select an entry even if only one choice remains or the pilot can indicate no selection using LS key 6R as described above.
  It is possible to have more than five waypoints or navaids with the same IDENT. Therefore the vertical slew function must apply to this page.
  There are many waypoint identifiers that use an ICAO phonetic alpha character for their names. When an ICAO phonetic alpha character is used as a waypoint name (Alpha, Bravo, Charlie, etc), the equivalent letter (A, B, C, etc), is used followed by a minus (-) sign and the two letter ICAO code for the country in which the waypoint is located, to produce a four character identification code. When more than one waypoint in a country has the same phonetic name, uniqueness is obtained by adding a numeric character after the ICAO country code.
  Examples : Waypoint ALpha in France becomes A-LF
  Fit waypoint Echo in England becomes E-EG1
  Second waypoint Echo in England becomes E-EG2
  When a double phonetic, such as Tango India, is used as the waypoint





BM5 34 63 00 0 CCMO

Duplicate Names
Figure 072

name, the two letters represented by the phonetics are used ahead of the minus sign and country code.
Example : Waypoint Tango India in Mexico becomes TI-MM
When doing a data base search for an identifier, the FMC looks only at the characters prior to the minus sign if there is no minus sign in the pilot entry. If there is a minus sign in the pilot entry, it searches for the entire identifier.
If no minus sign has been entered and there are duplicate names (considering only the characters before the minus sign in the data base search), this page will be displayed, and in columns 2-6 the entire identifier will be displayed including the character after the minus sign).
In the preceding figure, E was entered as a waypoint identifier, and the data base search found four waypoints with an E followed by a minus sign, so those four waypoints are displayed as duplicates. (Ref. Fig. 072).
In the above example if E-LS had been entered instead of just E, this page would not have been reached because E-LS would have been a unique name.

(15)Engine out key (ENG OUT)

(a)Results of pressing the ENG OUT key

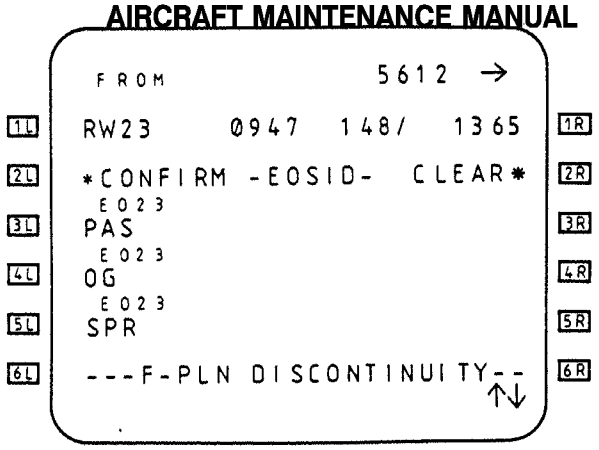
The ENG OUT key does not have a specific page associated with it but it modifies the pages that have been explained in previous sections. The following pages may be affected by the ENG OUT key being pressed.

- Both active flight plan pages
- MODE page

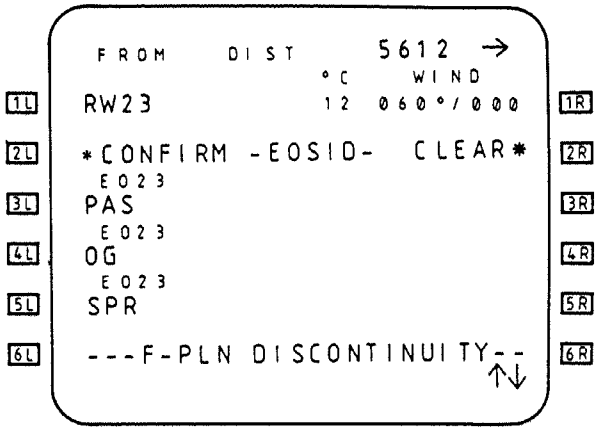
When the FMC is operating in the two-engine state, pressing the ENG OUT key or ENGINE 1 FAIL or ENGINE 2 FAIL discretes (from TCC) going from low to high has the same effect and may or may not cause the displayed page to change. If an EOSID has previously been defined for the origin airport and the aircraft has not yet reached the EOSID diversion point the F-PLN Page A will be displayed with the EOSID displayed and a prompt just prior to the EOSID diversion point. This prompt allows the pilot to confirm or clear the EOSID by pressing the appropriate LS key. If the EOSID is confirmed, the ENG OUT performance computations are automatically activated. If the EOSID is cleared, the EOSID is no longer displayed and the ENG OUT performance computations are not activated. If there has not been an EOSID defined previously or the aircraft is beyond the EOSID diversion point, F-PLN Page A is not automatically displayed but the MODE page is displayed with an ENG OUT CONFIRM/CLEAR prompt in line 6L-6R. With this prompt the pilot may confirm or clear the ENG OUT by pressing LS key 6L or 6R at which time the MODE page will be displayed.

If the A/C is above the maximum ENG OUT altitude when the ENG OUT is confirmed, the FMC will display drift Down (D/D) point on the F-PLN page. To reselect the two-engine state, the pilot must again press the ENG OUT key which causes the MODE page to be displayed with the ENG OUT CONFIRM/CLEAR prompt in line 6L-6R. Selecting CLEAR would cause ENG OUT to be de-activated and performance predictions to revert to the two-engine state. If the confirmed engine-out caused an EOSID to be inserted into the flight plan then this would be maintained on deselection of ENG OUT. Deselection of ENG OUT is only possible by pilot action, (Clear Eng Out on Mode page) and the state of the TCC ENGINE FAIL discretes is not considered during engine out.

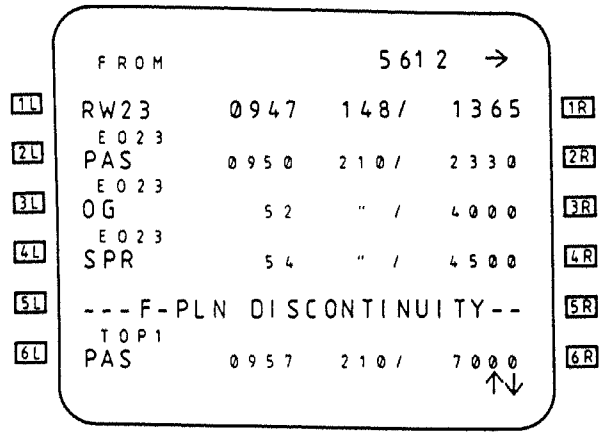
(b)F-PLN A and B with EOSID
(Ref. Fig. 073)
- Access - Press ENG OUT key or detect the ENGINE 1 FAIL OR ENGINE 2 FAIL discretes (TCC) going from low to high if the aircraft is not laterally beyond the EOSID diveion point in the flight plan.
- Purpose - Modify the flight plan to include an engine out SID and confirm this SID so it will become active.
- Data Fields
  1L - The FROM waypoint is displayed at the top of the page.
  The EOSID diveion point is PAS. The flight plan is not changed up to this point but the EOSID is displayed here. The CONFIRM/CLEAR prompts are displayed immediately before the EOSID diversion point. Between the last EOSID waypoint and the EOSID diversion point in the original flight plan waypoint, there is a discontinuity.
  To change the lateral flight plan to fly the EOSID, the CONFIRM LS key should be pressed. This also activates the ENG OUT performance computations. To cancel the EOSID and return the F-PLN page to the way it was, the pilot could press the CLEAR LS key or do nothing and wait until the aircraft passes the EOSID diversion waypoint. In either case ENG OUT is not made active.
  There will not be any preplanned performance predictions on engine out SIDs. The EOSID must be confirmed before any predictions are computed. However, any constraints will be displayed.
  No lateral or vertical revisions can be made to the flight plan before the engine-out condition is confirmed or cleared. Access to the LAT REV, VERT REV pages is not allowed (message 15 is displayed) until the engine-out condition is confirmed or cleared.



F-PLN PAGE A (EOSID NOT CONFIRMED)



F-PLN PAGE B (EOSID NOT CONFIRMED)

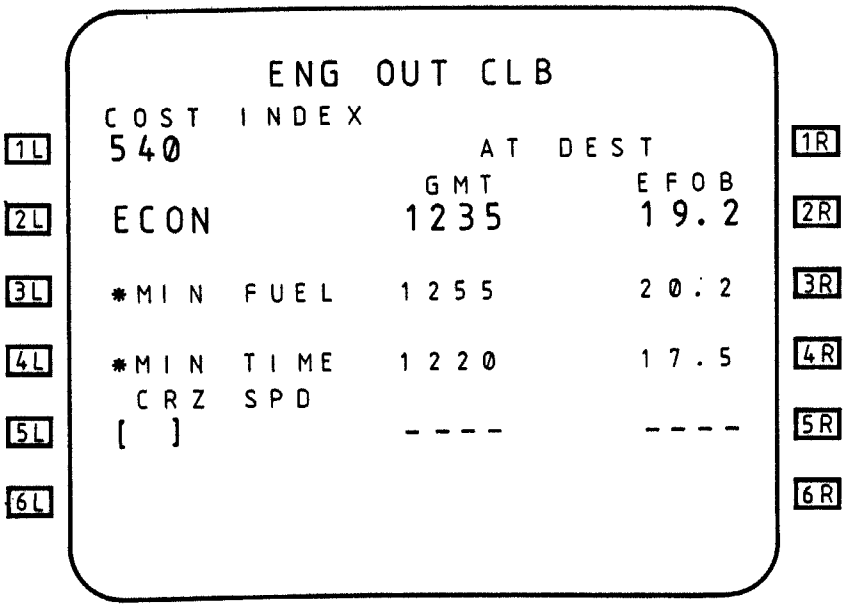


F-PLN PAGE A (WITH CONFIRMED EOSID)

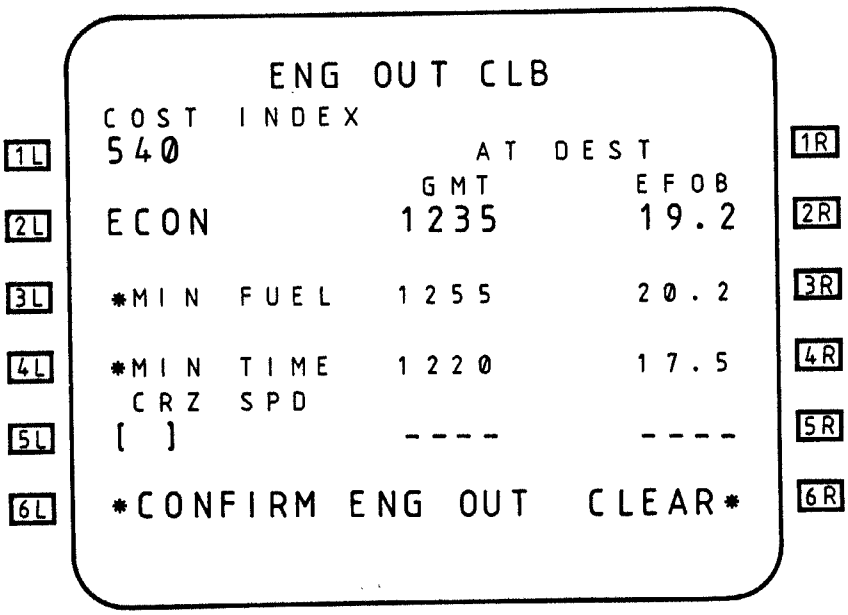
BM5 34 63 00 0 CKMO

F-PLN A and B with EOSID
Figure 073

(c)MODE page with ENG OUT mode
(Ref. Fig. 074)
Except for the title and the CONFIRM/CLEAR message the MODE for format is identical for both two-engine and engine-out operation.
- Access - MODE key when ENG OUT mode is active. Press ENG OUT key or detect a low-to-high transition on the ENGINE 1 FAIL or ENGINE 2 FAIL discretes (TCC) if the aircraft is laterally beyond the EOSID diversion point or there is no EOSID within the flight plan.
- Purpose - To modify the selected mode or activate the ENG OUT mode.
- Data Fields
  Title - Same as MODE page except that ENG OUT is displayed right justified in columns 6-13 when the ENG OUT mode is active.
  1L-5L - Same as MODE Page
  If this page is accessed via second case above, line 6L-6R displays the prompt *CONFIRM ENG OUT CLEAR* as shown in (Ref. Fig. 074)
  If the ENG OUT is confirmed (by pressing LS key 6L), ENG OUT becomes active and the display appears as shown in (Ref. Fig. 074) figure.
  If the ENG OUT is cleared (by pressing LS key 6R), ENG OUT is not made active and the display appears as a normal MODE page.



MODE PAGE (ENG OUT)



CONFIRM ENG OUT CLEAR

BM5 34 63 00 0 CLMO

MODE Page with ENG OUT Mode
Figure 074

3. Basic Lateral Navigation

This paragraph describes the elementary lateral navigation functions performed by the FMS.

A. Waypoints, Pseudo Waypoints

The FMS has the capability of computing or handling waypoints or pseudo waypoints from the following list :

(1)Leg defining waypoints

- Lat./Long
  Place/bearing/distance
  Waypoint identifier
- Turn point used in tactical "Direct to" and "Hold at present position"
- Altitude termination.

(2)Pseudo waypoints (Ref. Table 10) (Ref. Fig. 075, 076)

These waypoints are not leg defining.
Although the pseudo waypoints are defined by the lateral function, they are repeated below to show their influence on CDU display.

- Thrust reduction altitude point
- Acceleration altitude point
- Speed limit point (250 Kts - 10.000 Ft.)
- Clearance altitude (FCU) : LEVEL
- Altitude intercept point
- Top of climb
- Engine out drift down point, where engine out, descending aircraft will or would reach maximum engine out altitude
- Along track offset waypoint (defined by distance fore or aft a leg defining waypoint)
- Step climb or descent point
- Profile intercept point in conjunction with an immediate descent
- Top of descent.

TABLE 10
PSEUDO WAYPOINTS

CDU DISPLAY	PSEUDO WAYPOINT	DESIGNATION	(4) ACCESS TO LAT REV	(4) ACCESS TO VERT REV	(4) CLR FUNCTION AVAILABLE
(THR) (1) (RED) (3)	Thrust Reduction Altitude	Inserted into the flight plan at the point where the A/C will cross the THR reduction altitude. This value defaults to 1500 feet above the airport elevation but may be changed by the pilot on the T/O page.	NO	NO	
(ACCEL) (1) (3)	Acceleration Altitude	Inserted into the flight plan at the point where the A/C will cross the acceleration altitude. This altitude defaults to 3.000 feet above the airport elevation but may be changed by the pilot on the T/O page.	NO	NO	
(SPD) (1) (LIM)	Speed Limit	The speed and altitude are displayed as constraints on the right half of the F-PLN Page A. This is an altitude related speed limit associated with airspace the A/C is in. The speed limit is inserted into the flight plan at the point where the A/C will cross the speed limit altitude.	NO	YES	YES
(LEVEL) (1) (2)	Clearance Altitude	Inserted into the flight plan at the point where the A/C will intercept the clearance altitude.	NO	NO	NO
(HHHHH) (1)	Altitude Intercept Point	HHHHH is altitude input by pilot. The pilot enters this altitude via the scratchpad. The FMC	NO	NO	YES

CDU DISPLAY	PSEUDO WAYPOINT	DESIGNATION	(4) ACCESS TO LAT REV	(4) ACCESS TO VERT REV	(4) CLR FUNCTION AVAILABLE
		inserts it into the flight plan at the point where it predicts the A/C will cross this altitude. Only one altitude intercept point can be in the flight plan at any time. If a second altitude is entered the first will be deleted. This waypoint will not be displayed if the altitude is the same as the cruise altitude, speed limit altitude, clearance altitude, D/D altitude, THR RED ALT, or ACCEL ALT.			
(T/C)	Top of Climb	Inserted into the flight plan at the point where the FMC calculates the A/C will reach the cruise altitude or step altitude if a step climb.	NO	YES	NO
(S/C) (1)	Step Climb Point	Inserted into the flight plan at the point where the pilot has inserted a step climb (when the step climb will begin).	NO	YES	YES
(D/D)	Engine Out Drift Down Point	If in the ENG OUT mode and the A/C is above the maximum altitude it can fly with only one engine. This pseudo waypoint is inserted at the point where the A/C will intercept its maximum altitude if it drifts down.	NO	NO	NO
(AA-NN) (1)	Along Track Offset Waypoint	AA is the first two characters of the waypoint the offset is defined	NO	YES	YES

			(4)		
CDU DISPLAY	PSEUDO WAYPOINT	DESIGNATION	ACCESS TO LAT REV	ACCESS TO VERT REV	CLR FUNCTION AVAILABLE
		from (defining waypoint). NN is the offset distance - is before defining waypoint. + is after defining waypoint. This waypoint is used to define a constraint or certain distance (along lateral path) from a fixed waypoint. If the defining waypoint is deleted from the flight plan the along track offset is deleted. If the altitude constraint is deleted the along track offset is also deleted. No SPD, TIME, TEMP, or WIND entries allowed at this waypoint.			
(S/D) (1)	Step Descent Point	Inserted into the flight plan at the point where the pilot has inserted a step descent (when the step descent will begin.	NO	YES	YES

			(4)		
CDU DISPLAY	PSEUDO WAYPOINT	DESIGNATION	ACCESS TO LAT REV	ACCESS TO VERT REV	CLR FUNCTION AVAILABLE
(I/P)	Intercept Path Descent	Displayed at the point where the A/C will intercept the predefined vertical path when A/C is doing an immediate descent.	NO	NO	NO
(T/D)	Top of Descent	Inserted into the flight plan at the point where the FMC calculates the A/C should start its descent.	NO	YES	NO

NOTE : (1) Indicates that pilot may enter or modify this pseudo waypoint through the CDU.
(2) The pseudo waypoint level will replace T/C when the selected altitude from FCU is equal to or higher than the altitude at T/C.
(3) These pseudo-waypoints are modifiable on the TO/APPROACH page.
(4) More details are given in paragraph (F-PLN).

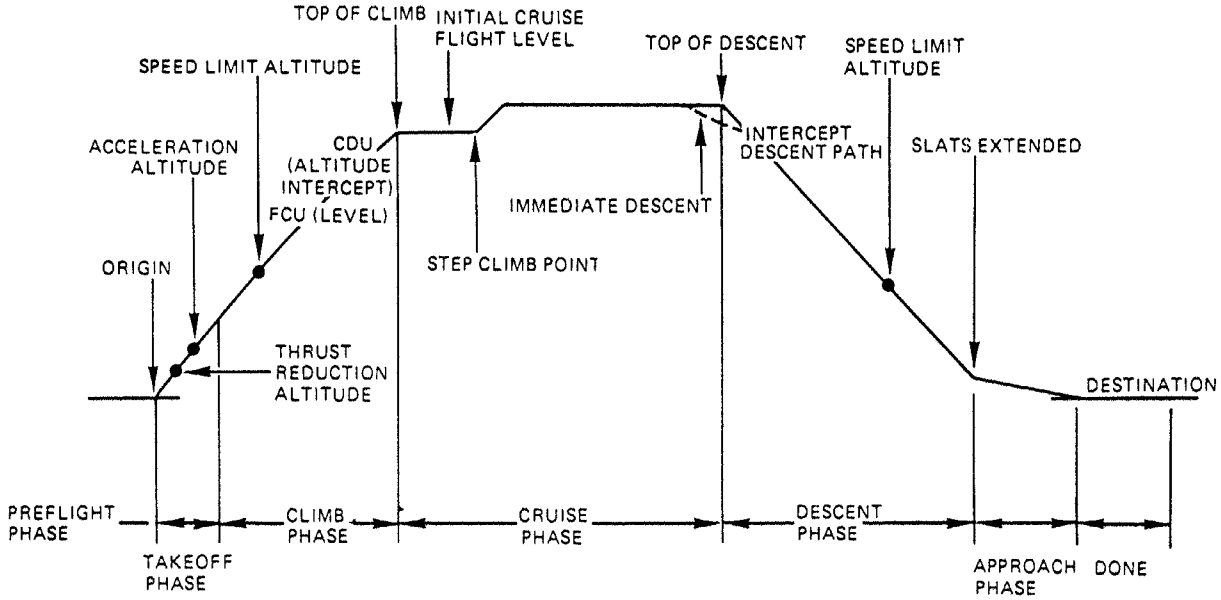
B. Legs

(1)Overview

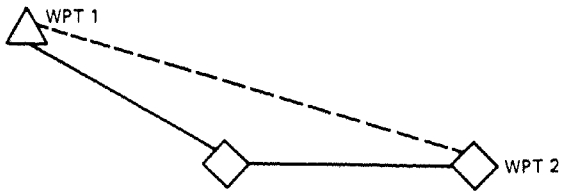
Disregarding leg switching geometry, great circle legs connect defining waypoints. Table 11 provides definition for all possible leg types. Except for procedure turn and holding with manual termination, turning point and present position these legs are coming from the data base.

En route leg switching geometry at geographical waypoints not designated as "overhead" waypoints is nominally tangential to both inbound and outbound legs and contained within the band extending 5NM on either side of each leg while all the space available shall be used. Minimum and maximum nominal bank angles are 5° and 25°. Deviations from nominal leg exist when the space available is too small, in which case the outbound leg is allowed to be overshot. When the nominal switching would begin before 20 NM ahead of the waypoint, 20 NM is used as a limit. Terminal area leg switching is constrained by a nominal bank angle of one degree per degree of track change but bounded by a minimum limit of 10° and 2 maximum limits, 15° and 25°, depending on stall margin. Linear interpolation between these last two values is performed between 1.3 and 1.35 Vs. Terminal area criteria are IAS below 380 kts and altitude below 20000 ft.

At geographical waypoints designated as turn points used in tactical



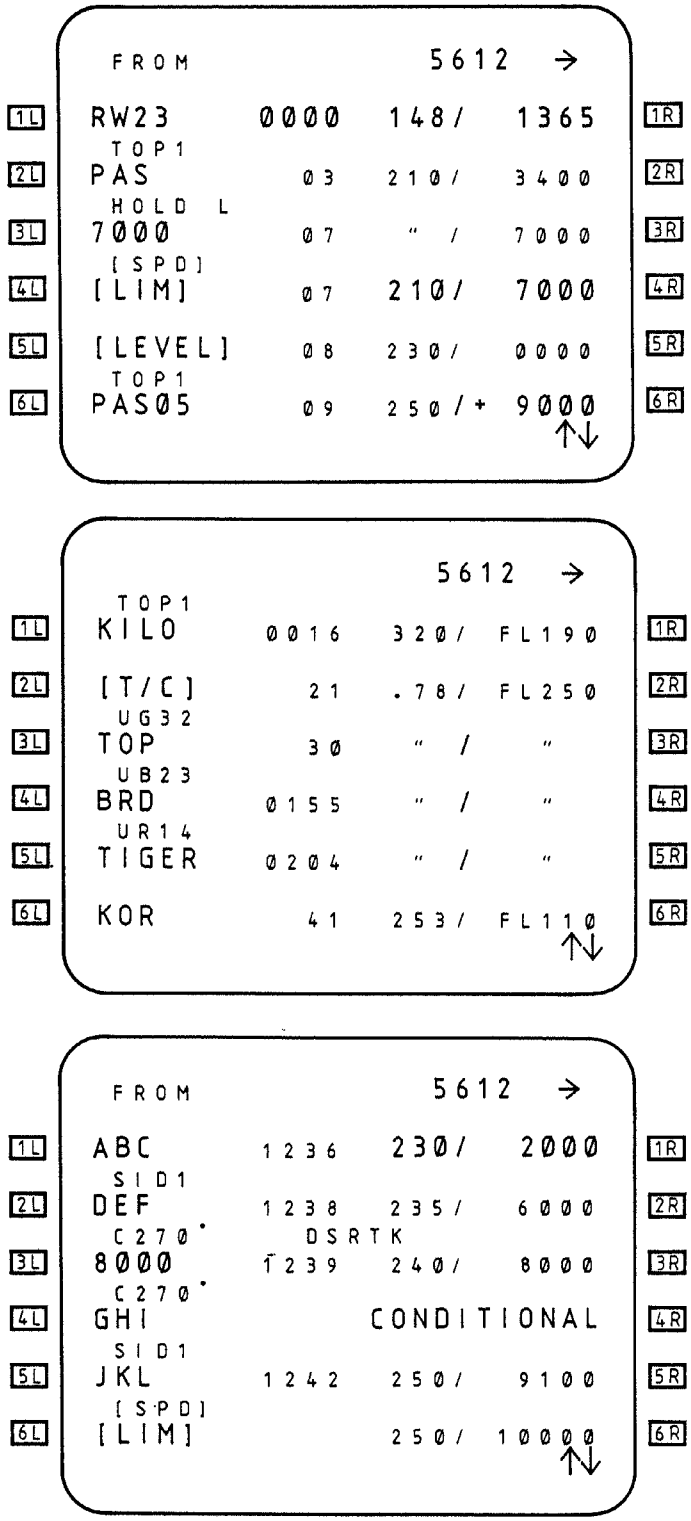
PART A:ELEMENTS OF VERTICAL TRAJECTORY



PART B: ALONG TRACK OFFSET GEOMETRY

8M5 34 63 00 0 AAMO

Pseudo Waypoints
Figure 075



Examples of Pseudo WPTs
Figure 076

BM5 34 63 00 0 LRM0.00

"Direct to" and leg defining altitude intercept points, leg switching occurs at this waypoint and the turn proceeds until the bearing line from the next waypoint becomes tangential to the trajectory.
Conditional leg switching is defined as making an altitude intercept waypoint.
Conditional legs. A conditional leg is a path/termination that maintains the same path but terminates in one of two ways : at the normal termination of the leg or at an altitude, whichever occurs first. There are four path/terminations that can have a conditional altitude termination : CF. TF. VR and VD. The altitude is supplied by the data base.

(2)Holding patterns, procedure turns
Holding patterns are defined to the FMS by the following parameters :
- Holding at a fix or at present position
- Inbound course
- Turn direction
- Pattern leg distance or time.

Holding patterns are either databased or manually entered.
The following figure defines the FMC logic conditions when "IMM EXIT" is asked by the crew via the CDU.
Procedure turns are defined to the FMS by the following parameters :
- Waypoint
- Outbound course
- Inbound course
- Inbound leg distance

Procedure turns are either databased for PI or manually entered for PM.

TABLE 11
LATERAL DEFINING LEGS

CDU DISPLAY	PATH/TERMINATOR	COMMENTS	ACCESS TO LAT REV	ACCESS TO VERT REV	
(1) WPT	DF TF IF	When first line is blank, a direct leg is assumed.	YES	YES	
---CXXX°----- WPT	CF	XXX is the defined course	YES	YES	
(1) AWY WPT	TF DF	If defined as part of a terminal area procedure or airway, that procedure name is displayed.	YES	YES	
(1) LLNN	TF DF	The waypoint was a LAT/LONG input by the pilot.	YES	YES	
(1) PBD-XX	TF DF	Place/Bearing/Distance waypoint defined by pilot	YES	YES	
DD NAV WPT	AF	DD is the distance of the arc. NAV is the navaid the arc is defined from. WPT is the terminating waypoint.	YES	YES	
HOLD L(3) HHHHH	HA	L is direction of bank (L-left or R-right) HHHHH terminating altitude.	YES	YES	
(1) HOLD L MANUAL	HM	L is direction of bank (L-left, R-right)	YES	YES	
HOLD L WPT	HF	L is direction of bank (L-left, R-right)	YES	YES	
(1) PROC T MANUAL	PM	Previous waypoint is where the turn is started	YES(2)	YES	

CDU DISPLAY	PATH/TERMINATOR	COMMENTS	ACCESS TO LAT REV	ACCESS TO VERT REV	
PROC T INTCPT	PI	Previous waypoint is where the turn is done.	NO	YES	
HXXX°(3) HHHHH	VA	XXX is heading HHHHH - terminating altitude	YES	YES	
HXXX° WPTRRR	VR	XXX is heading. WPT from WPT . RRR is radial from WPT.	YES	YES	
HXXX° NAV/DD	VD	XXX is heading - NAV is DME station. DD is DME distance.	YES	YES	
HXXX° INTCPT	VI	XXX is heading. The following leg defines the intercept termination.	YES	YES	
HXXX° MANUAL	VM	XXX is heading	YES	YES	
WPT XXX HHHHH (3)	FA	XXX is course from the previous waypoint. HHHHH is terminating altitude. WPT is the fixed waypoint from which the course is defined.	YES	YES	YES
WPT XXX MANUAL	FM	XXX is the course. The course is from previous waypoint. WPT is the fixed waypoint from which the course is defined.	YES	YES	
LABEL (3) HHHHH	Conditional altitude termination	HHHHH is the conditional altitude termination. LABEL is as defined for the associated leg termination. See paragraph "legs" for which legs can contain conditional altitude termination	NO	YES	
T-P	Fixed waypoint	Displayed when a HOLD at	YES	YES	

CDU DISPLAY	PATH/TERMINATOR	COMMENTS	ACCESS TO LAT REV	ACCESS TO VERT REV	
	Turn Point	present position is executed. This is a fixed waypoint at the LAT/LONG when the HOLD is inserted.			

CDU DISPLAY	PATH/TERMINATOR	COMMENTS	ACCESS TO LAT REV	ACCESS TO VERT REV	
PPOS	Present Position	Displayed as the FROM waypoint if the A/C is in a discontinuity and does not meet the criteria for activation on the next leg.	YES	YES	NO

NOTES : (1) Signifies that this leg may be inserted by the pilot through the CDU. All other legs can only be entered from the data base.
(2) If PM leg is the TO waypoint, access to LAT REV will not be allowed.
(3) Altitude terminations may be displayed as flight level(FLHHH) or altitude (HHHHH). Leading zeros are suppressed when altitudes are displayed

(4)Flight plan assembling elements
The lateral flight plan (active or secondary) is made up of a series of the preceding legs which are connected to form the intended lateral flight plan.

(a)Lateral F-PLN structure
The structure of a complete lateral flight plan is as follows :

Primary F-PLN
- From waypoint (may also be origin)
- Primary route legs.
- Destination fix
- Missed approach legs

Alternate F-PLN
- Alternate origin fix
- Alternate route legs
- Alternate destination fix
- Alternate destination missed approach legs.

(b)Lateral revision possibilities
The following is a list of the lateral revision possibilities via the CDU :
- company route (which can define SIDS, STAR, approaches and alternate)
- alternate by route number
- from - to (origin and destination)
- from - to (destination and alternate)
- SIDS and engine out SID selection
- STARS selection
- airways
- holding with manual termination (from data base or by default)
- procedure turn with manual termination (pilot enter)
- new waypoint(s) or waypoint(s) deletion
- new route to and new alternate
- direct To (except for secondary F-PNL)
- parallel offset (except for secondary F-PNL)

If some parts of the lateral F-PNL are not tied together a "DISCONTINUITY" appears in the F-PLN and the pilot can clear the discontinuity. The system gives also the capability to build a F-PLN waypoint by waypoint and to add in the data base 20 waypoints (including runway) and 20 NAVAIDS which the pilot can call by an identifier.

4. Basic vertical navigation

This section describes the elementary vertical navigation and performance functions performed by the FMS.

A. Altitude control and constraints (Ref. table 12)

Altitude Definition

(1) Cruise Altitude : crew selected or system defined altitude via data base for cruise. Predictions are based on this CRZ FL.

(2) Clearance Altitude : target altitude set by the crew on the FCU.

- In climb, if the FCU altitude is dialled higher than the cruise altitude, the FCU altitude becomes the CRZ altitude.
- In level flight, pulling the altitude knob is furthermore necessary to redefine an FMS altitude for prediction or/and guidance.

(3) Altitude constraints : altitude constraints (AT, AT OR BELOW or AT OR ABOVE) shall be applicable to individual waypoints in the climb and in the descent phases. Altitude constraints are crew entered or coming from the data base.

(4) Vertical guidance rules :

- the FMS will not command the aircraft to fly away from the clearance altitude
- when going to a new altitude, the FMS will capture the clearance altitude or a current constraint, whichever is intercepted first
- conflicts may exist as a result of crew entries while the aircraft is climbing or descending and shall result in a level off (e.g. : in climb the FCU altitude is dialled below an altitude constraint and the aircraft altitude)

(5) Other constraints : speed and time

AT and BELOW speed constraints associated with waypoints in the climb and descent phases or time constraints associated with any geographical but single waypoint can modify the vertical profile. Speed or time constraints are crew entered. Speed constraints can also be provided by the data base. A speed constraint can be associated with an altitude constraint.

TABLE 12
CONSTRAINT/LEG COMPATIBILITY

	Constraint Types				
Leg Types	Altitude	Speed	Time	FPA	Along Track Offset
Fixed WPT Termination (IF, AF, CF, DF, TF, HF)	X(1),(4)	X	X(2)	X(3)	X(5)
Altitude Termination (FA, HA, VA)	O	X	O	O	O
All Others (1), (6) (FM, HM, PI, VI, VD, VM, VR, PM)	X(4)	X	O	O	O

X - Compatible
O - Not compatible

NOTES : (1) If the leg is conditional (possibility for CF, TF, VD, VR), an altitude constraint is not allowed.
(2) Only one is allowed in the flight plan at a time.
(3) It can only exist on a CF leg, which also has an AT altitude constraint at that waypoint (fixed waypoint of CF leg).
(4) An altitude constraint cannot exist above the cruise altitude or below the present A/C ALT if the aircraft is in CLB or above the present A/C ALT if the aircraft is in DES.
(5) Only one along track offset can exist in the flight plan at a time. The ALONG TRK OFST cannot be referenced to the origin, destination, or FROM waypoints.
(6) No constraints are allowed at T-P, PPOS, or discontinuities.

B. Vertical F-PLN Structure

The structure of a complete vertical flight plan is as follows :

```
                - Thrust reduction altitude
Primary climb |  Acceleration altitude
              |  Climb constraints
              |_ Climb speed limit
               - Cruise altitude (T/C, T/D)
Primary cruise |  Cruise constraint
               |  Step CLB or DES
               |_ Cruise constraint
                - Descent constraint
Primary descent |  Descent speed limit
                |_ Approach constraint
Primary missed approach : missed approach constraints
Alternate climb - Climb constraints
                | Speed limit
Alternate cruise : - Cruise altitude (T/C, T/D)
Alternate descent  - Speed limit
                   |_ Descent constraint
Alternate missed approach : missed approach constraint.
```

Most of the elements listed cannot exist without at least a partial lateral flight plan. These vertical flight plan elements appear on the F-PLN page interleaved with the lateral flight plan in their proper order of ocurrence during the flight.

The element order is according to their appropriate reference parameters

- constraints (speed and/or altitude, Time) are referenced to lateral waypoint or paths and therefore appear with their associated waypoint
- speed limit and cruise altitude (T/C, T/D) appear where their defining altitude is predicted to be reached.

(1)Atmospheric computation

Altitude, Temperatures

Aircraft altitude control and performance computations at the current aircraft conditions use pressure altitude, QNH setting and present temperature.

Prediction computations use the ICAO atmosphere model while taking into account aircraft present conditions as well as destination QNH, tropopause altitude and temperatures at origin or cruise waypoints which are all crew defineable.

Winds

Wind predictions which are used for aircraft performance predictions, are based on crew wind inputs at waypoints (origin, CRZ and destination), wind inputs at altitudes (for descent), actual wind at the current position and a prediction algorithm. If no wind is defined in preflight, climb or cruise phase, this data defaults to zero (in direction and intensity). If no wind is defined in descent, a vertical wind model is considered by default which takes into account the actual wind in CRZ.

(2)Modes
(a)Performance computations are based on the following modes.
Strategic modes govern the computation of guidance and prediction parameters for the entire flight. They consist of :
ECON, for a minimum cost flight, given a ratio of fuel-to-time cost via data base and crew modifiable (this mode is taken by the **FMS** if no other mode is selected).
MIN FUEL, for a minimum fuel flight
MIN TIME, for a minimum time flight constrained by **VMO/MMO, 1.2** g buffet margin and maximum cruise thrust.
(b)Tactical modes respond to situations which require specific phase-related (climb, cruise, descent) control. Both guidance and predictions are provided. They consist of :
MAX CLB, for maximum climb angle
MAX END, for maximum endurance in the cruise phase and in the descent phase
MAX DES, for maximum descent
SPD,
for crew selected speed (**CAS** or **M**) target selection.
(c)In addition, three situational commands are available which permit the crew to comply with short term operational requirements. They are "immediate descent", "maximum endurance", "immediate climb" and "deceleration".
(3)Predictions
For engine out conditions, all the strategic or tactical modes and the situational commands are available except during climb and drift down situation where specific speed and prediction computations are performed.
Prediction of a number of variables is provided which take into consideration such constraining elements of the flight as lateral flight plan, constraints at waypoints, entered cruise altitude, entered winds and temperature, aircraft weight and selected mode. Individual aircraft performance variations are compensated for by adaptation of the system as a result of actual performance during preceding flights.
For decision making purposes, predictions are available for other modes. Maximum and optimum altitudes are available at all times.
Time and speed predictions are provided at geographical waypoints in all phases. Altitude predictions are provided at waypoints during the climb and descent phases. Top of descent is predicted so as to meet descent constraints. Step climb information and insertion in the flight plan during cruise is available if the pilot introduces a new flight level.
Fuel is predicted at destination and alternate airport. Fuel predictions are based on crew selectable fuel allotments and result in the display to the crew of extra fuel.

(4)Takeoff and approach
Takeoff vertical guidance up to the acceleration altitude (the pilot can modify it) is only an AFS function. FMS must be armed to command thrust reduction at a crew alterable altitude and to be coupled in pitch at acceleration altitude. Predictions are based on flying at V2 + 10 up to this point.
If an engine out situation is confirmed below the engine out acceleration altitude and profile has been armed and the TAS is less than Vfto, then the FMS will capture the engine out acceleration altitude or the clearance altitude, whichever is lower.
If an engine out situation is confirmed above engine out acceleration altitude and the IAS is less than Vfto, then the FMS commands an acceleration until Vfto is attained.
Vertical approach guidance is available along the defined horizontal path to the ILS capture for precision approaches or down to runway threshold for non-precision approaches. Databased non-precision approaches can either be constructed to approximate published VOR or NDB approaches or be airline generated. Appropriate path, speed and configuration commands compatible with existing constraints shall be provided.

(5)Vertical element priorities
There are normal and abnormal circumstances where two or more vertical profile controlling elements conflict with each other in trying to determine the vertical profile. Following table is a list of the various elements with their assigned priority level. This priority list is implemented so that if a conflict arises between two or more elements, the requirements of conflicting elements with the lowest priority level are relaxed in order to meet the requirements of the next higher conflicting priority level. Anytime this situation exists, the pilot is informed. Compromises in priority level 11 requirements are indicated by a change in the performance mode annunciation. Compromises in the requirements of levels 5 through 10 are indicated by CDU messages. If any requirement in levels 1 and 2 cannot be met, the Profile (PROF) mode will be automatically disengaged.

TABLE 13
VERTICAL ELEMENT PRIORITIES

Element	Priority Level	
Operational Limits	1	
Clearance Altitude	2	
Thrust Reduction Altitude	3	
Acceleration Altitude	4	Higher Priority
Altitude Constraint	5	
Flight Plan Vertical Path	6	
Cruise Altitude	7	
Speed Constraint	8	Lower Priority
Speed Limit	9	
Time Constraint	10	
Selected Performance Mode	11	
Thrust Derating	12	

The following examples illustrate the use of the table.

(a) The performance mode speed will be changed whenever required to meet the requirements of any other element.

(b) If a time constraint cannot be met without violating a speed constraint or speed limit, the time constraint is given up and the speed constraint or speed limit observed.

(c) If both an altitude constraint and a speed constraint at a waypoint cannot be met, the speed constraint is given up.

(d) The FMCS will maintain a flight plan vertical path even if a speed constraint is missed.

(e) If the cruise altitude is not reached before the planned descent path is intercepted, the cruise altitude is given up and the flight phase sequences to descent.

(f) The thrust is reduced at the thrust reduction altitude even if a constraint is missed which might be made with takeoff thrust.

(g) Thrust derating will be cancelled when the selected performance mode can no longer meet the requirements of any other element.

FMS CDU (3CK1, 3CK2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps/Plugs
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For FMS CDU 3CK1

PANEL	SERVICE	IDENT.	LOCATION
21VU	FMS/SYS1/SUPPLY	4CK1	101/J11
21VU	FMS/SYS1/DIM	5CK1	101/J12
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77

(b)For FMS CDU 3CK2

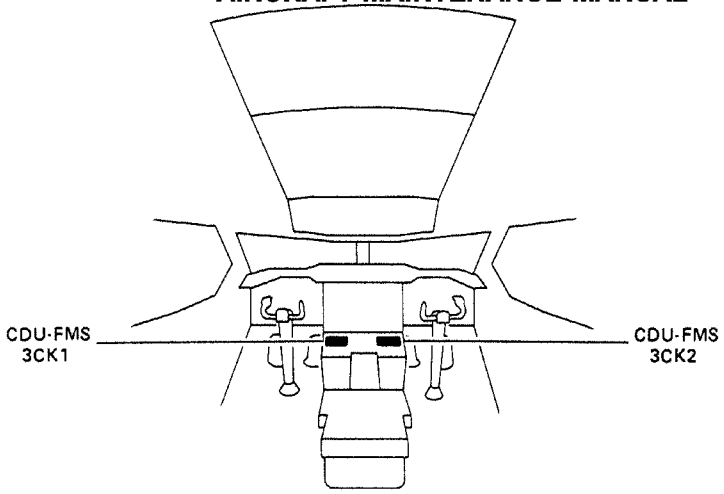
PANEL	SERVICE	IDENT.	LOCATION
21VU	FMS/SYS2/DIM	5CK2	101/J13
21VU	FMS/SYS2/SUPPLY	4CK2	101/J14
132VU	LIGHTING/INTEGRAL LT/C/B & OVHD & PED	3LF	322/N77

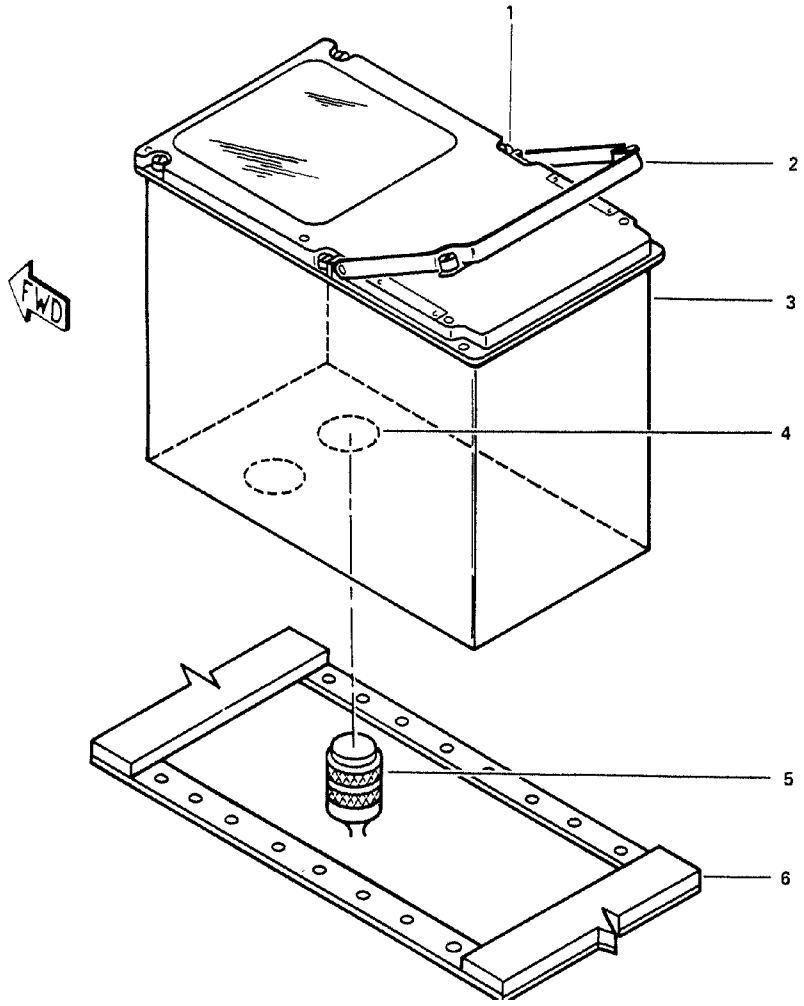
B. Removal

(1)Release the six quick release fasteners (1) on CDU (3).
(2)Raise handle (2).
(3)Pull the CDU out sufficiently to disconnect cable (5) from connector (4).
(4)Cap connectors (4) and (5).
(5)Remove CDU (3).

C. Installation

(1)Clean and inspect CDU interface and/or adjacent area.
(2)Remove blanking caps from connectors (4) and (5).
(3)Check for correct condition and cleanliness of electrical connectors.
(4)Connect cable (5) to connector (4) on CDU.
(5)Slide CDU (3) onto its mount (6) ; make certain that the CDU is in its right position.
(6)Lower handle (2).
(7)Press the CDU lightly to link the lower side to the upper side of the mount (6). Lock the six quick release fasteners (1), beginning with the two center ones.





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FMS CDU
Figure 401

(8)Remove safety clips and tags and close the following circuit breakers :
(a)For FMS CDU 3CK1 : 4CK1, 5CK1 and 3LF
(b)For FMS CDU 3CK2 : 4CK2, 5CK2 and 3LF

D. Test
Initial conditions.
- Correct electrical power supply
- Forward services ventilation system in operation
- Overhead panel circuit breakers closed, particularly those associated with NAVIGATION.

ACTION	RESULT
1. After CDU/FMC CRT warm uptime.	Check that : A/C STATUS page is displayed on CAPT (F/O) CDU.
2. On CAPT (F/O) CDU vary brightness of CRT display by means of BRT knob.	On CAPT (F/O) CDU check that CRT brightness increases and decreases.

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)De-energize aircraft electrical network.

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 24-41-00, P. Block 301 (Ref. Fig. 401)	AC External Power Control

2. Procedure

A. Job Set-Up

CAUTION : ANY ATTEMPT TO REMOVE/INSTALL THE FMC WHILE THE POWER IS ON WILL RESULT IN THE ELECTRICAL CONTACTS ARCING AND BECOMING BURNT.

(1)Open, safety and tag the following circuit breakers :
(a)For FMC1

PANEL	SERVICE	IDENT.	LOCATION
21VU	FMS/SYS 1/SUPPLY	4CK1	101/J11
21VU	FMS/SYS 1/DIM	5CK1	101/J12

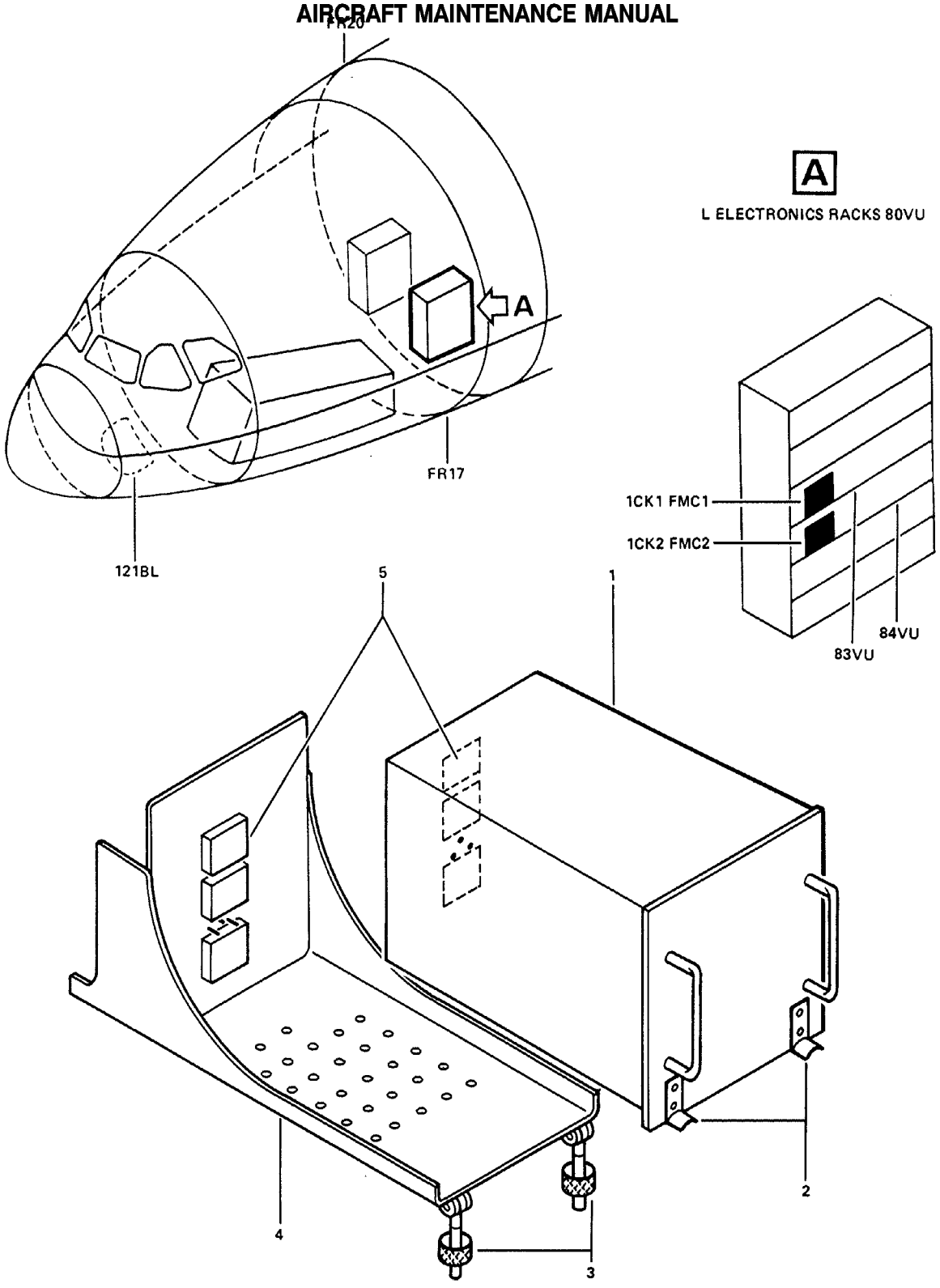
(b)For FMC2

PANEL	SERVICE	IDENT.	LOCATION
21VU	FMS/SYS 2/DIM	5CK2	101/J13
21VU	FMS/SYS 2/SUPPLY	4CK2	101/J14

(2)Open access door 121BL and gain access to FMC to be removed.

B. Removal
(1)Unscrew knurled nuts (3) on face of mount (4) and pivot them downwards.
(2)Take the handles and pull FMC from its mount with care.
(3)Remove FMC (1).
(4)Check for correct condition of the rack assembly, including rack electrical connectors and contacts.
NOTE : Replace any contact showing traces of pitting or burning.
(5)Blank electrical contacts.

C. Installation
(1)Clean and inspect FMC (1) interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (5).
(3)Check for correct condition of electrical connectors on the FMC and on the rack.
(4)Install FMC (1) in mount (4).



Flight Management Computer
Figure 401

(5)Engage knurled nuts (3) into studs (2) and tighten nuts.

D. Test
Initial conditions
- Connect electrical ground power unit and energize the aircraft electrical network.
- Make sure that electronics rack ventilation is correct.
- Remove safety clips and tags, and close circuit breakers 4CK1 and 5CK1 for FMC1 (4CK2 and 5CK2 for FMC2).

ACTION	RESULT
1. After CDU/FMC CRT warm up time.	Check that : A/C STATUS page is displayed on CAPT (F/O) CDU and LATERAL ONLY message is not displayed in the engine data field.
2. Make certain that updating of the data base : (applicability date) is valid.	If updating does not match, carry out an FMS data base loading procedure (Ref. 34-60-00, P. Block 301).
3. On CAPT (F/O) CDU vary brightness of CRT display by means of BRT knob.	On CAPT (F/O) CDU CRT brightness increases and decreases.

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
(3)Close access door 121BL.

ELECTRONIC INSTRUMENT DISPLAY - DESCRIPTION AND OPERATION

1. General

The EFIS (Electronic Flight Instrument System) enables display for the crew of flight path control and navigation data.

Each pilot has at his disposal two CRT display units on which is displayed all the information that is usually displayed by the following instruments :

- Attitude Director Indicator
- Horizontal Situation Indicator
- Mach-Airspeed Indicator
- Radio Altimeter Indicator
- Weather Radar Indicator
- Flight Mode Annunciator.

Thanks to the high level of flexibility of the CRTs, the EFIS makes it possible to display, at a given moment, only the information required by the present flight phase.

The upper instrument displays the information necessary for short-term aircraft control, hence the name : Primary Flight Display (PFD), that is : aircraft attitude, computed airspeed (VC) and Mach number, altitude and course deviations etc... The lower instrument Display (ND), displays the navigation information necessary for the flight phase : rose, flight plan, radar image...

2. Component Location
(Ref. Fig. 001)
(Ref. Fig. 002)

**ON A/C 001-100,

(Ref. Fig. 003)

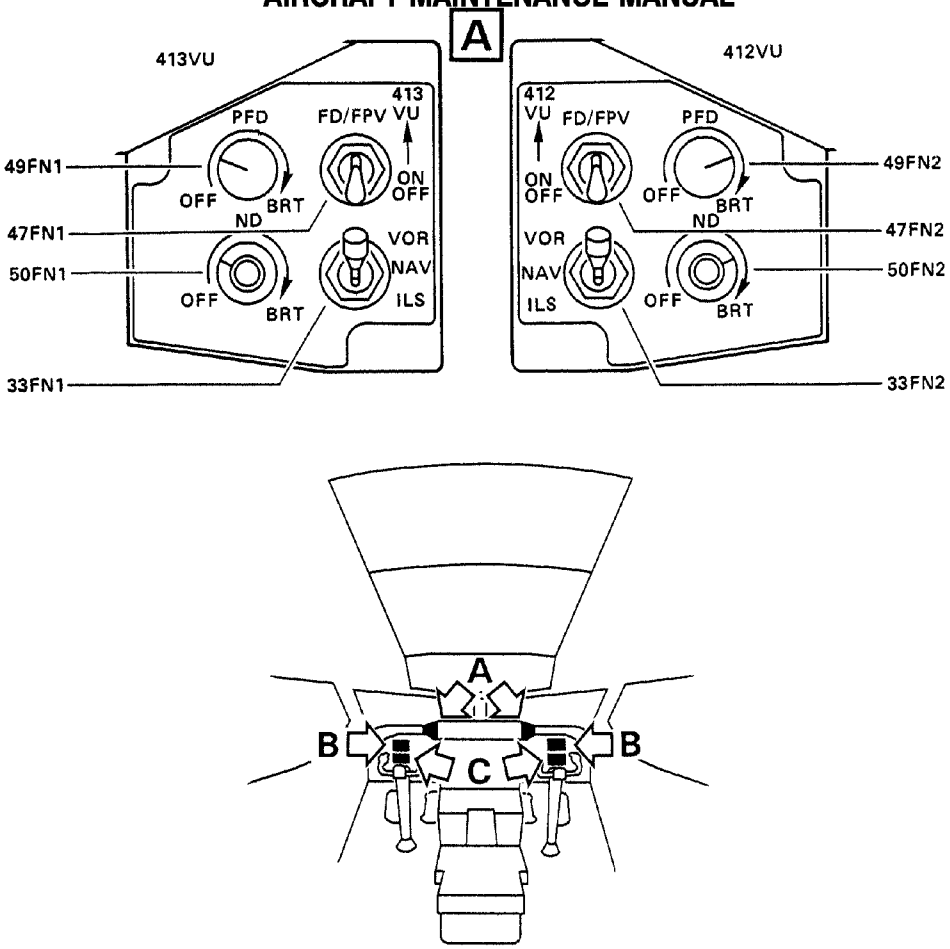
**ON A/C 101-200,

(Ref. Fig. 004)

**ON A/C ALL

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
9FN1	P/BSW-FD, CAPT	402VU	211		
9FN2	P/BSW-FD, F/O	406VU	212		
15FN1	P/BSW-ATT HDG, CAPT	402VU	211		
15FN2	P/BSW-ATT HDG, F/O	406VU	212		
28FN1	SGU-EFIS, 1	85VU	121		34-73-34
28FN2	SGU-EFIS, 2	86VU	121		34-73-34
28FN3	SGU-EFIS, 3	85VU	121		34-73-34
33FN1	SWITCH-VOR/NAV/ILS, CAPT	413VU	211		
33FN2	SWITCH-VOR/NAV/ILS, F/O	412VU	212		
34FN1	PFD-CAPT	3VU	211		34-74-22
34FN2	PFD-F/O	5VU	212		34-74-22
36FN1	ND-CAPT	3VU	211		34-75-22
36FN2	ND-F/O	5VU	212		34-75-22
**ON A/C 001-100,					
38FN1	P/BSW-EFIS SGU, CAPT	402VU	211		
38FN2	P/BSW-EFIS SGU, F/O	406VU	212		
39FN1	P/BSW-PFD/ND XFR, CAPT	402VU	211		
39FN2	P/BSW-PFD/ND XFR, F/O	406VU	212		
**ON A/C 101-200,					
38FN1	P/BSW-EFIS SGU, CAPT	402VU	211		
38FN2	P/BSW-EFIS SGU, F/O	406VU	212		
**ON A/C ALL					
42FN1	CTL PNL-EFIS, CAPT	13VU	210		34-73-11
42FN2	CTL PNL-EFIS, F/O	13VU	210		34-73-11
47FN1	SWITCH-FD/FPV, CAPT	413VU	211		
47FN2	SWITCH-FD/FPV, F/O	412VU	212		
49FN1	POT-PFD BRIGHTNESS ADJ, CAPT	413VU	211		
49FN2	POT-PFD BRIGHTNESS ADJ, F/O	412VU	212		

FIN	FUNCTIONAL DESIGNATION	PANEL	ZONE	ACCESS DOOR	ATA REF.
50FN1	POT-ND BRIGHTNESS ADJ, CAPT	413VU	211		
50FN2	POT-ND BRIGHTNESS ADJ, F/O	413VU	212		
55FN	P/BSW-EFIS INPUTS	470VU	212		
56FN	P/BSW-EFIS BITE	470VU	212		
19FL1	P/BSW-ADC INST, CAPT	402VU	211		
19FL2	P/BSW-ADC INST, F/O	406VU	212		
13WT	P/BSW-EFIS/DISPLAYS	470VU	212		



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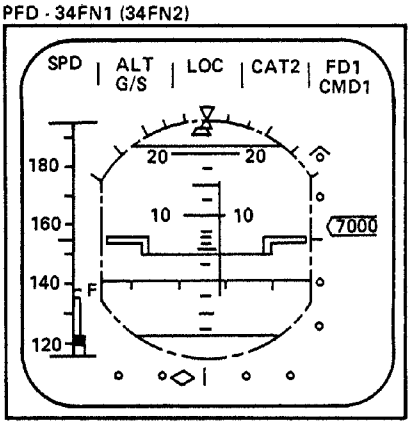

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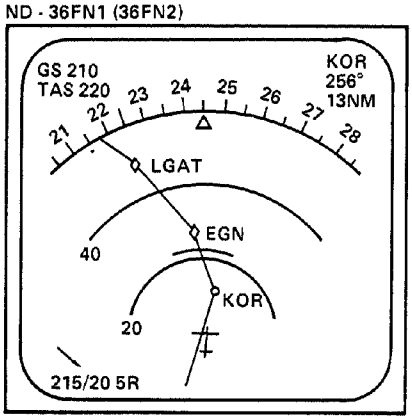

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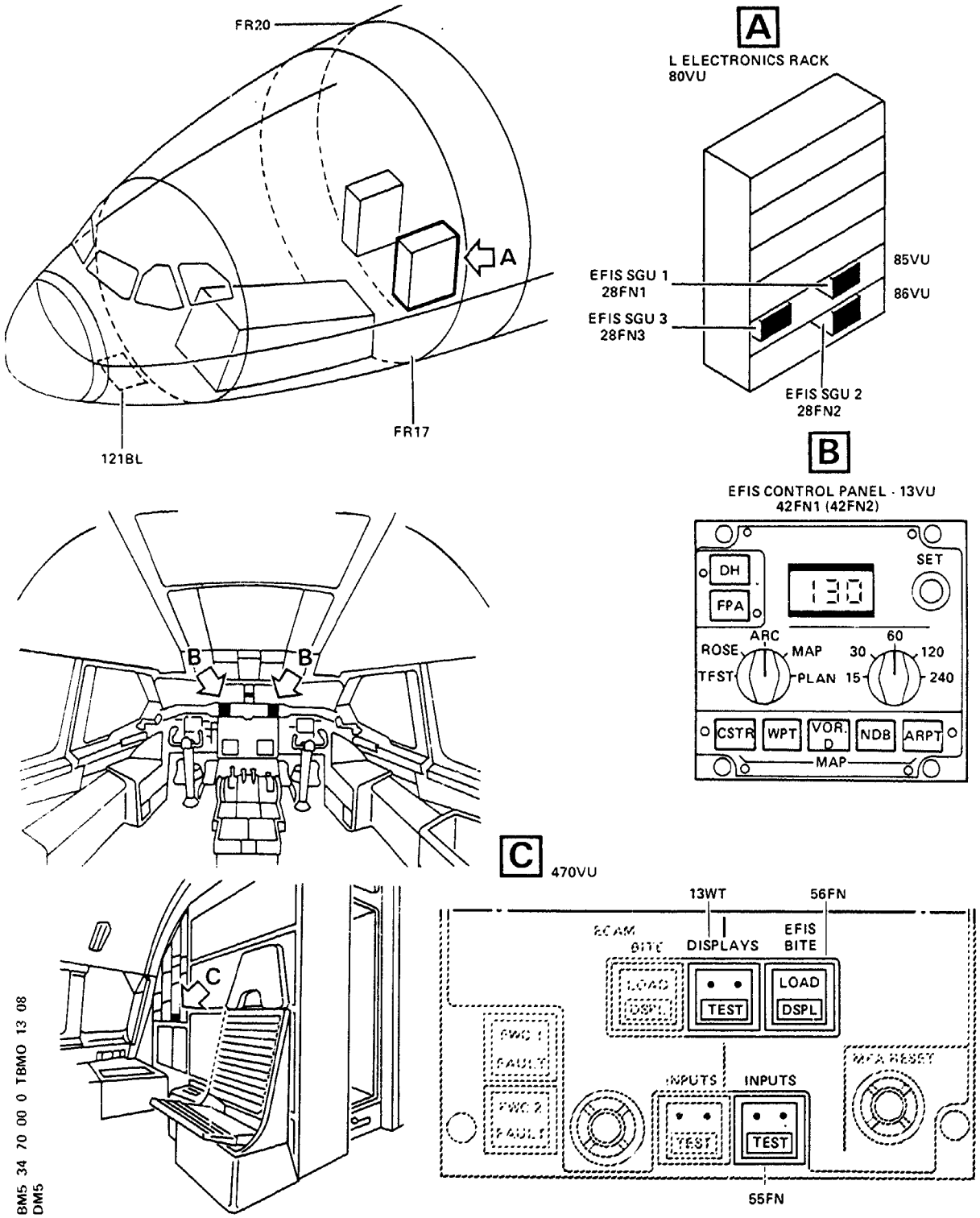
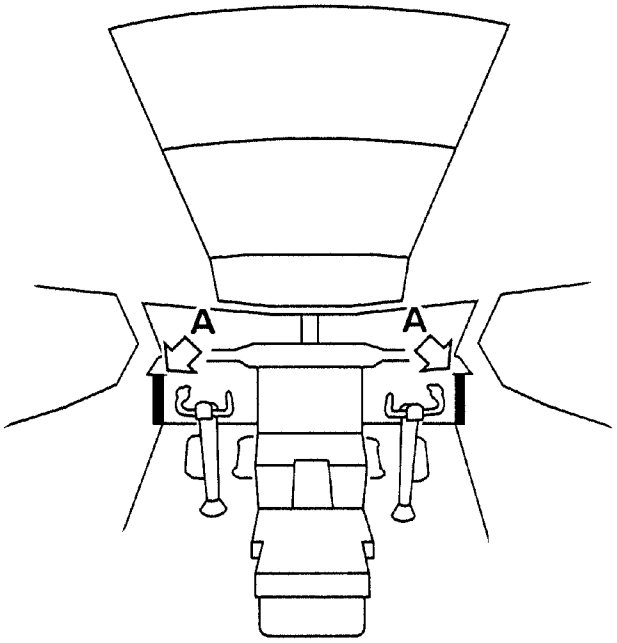
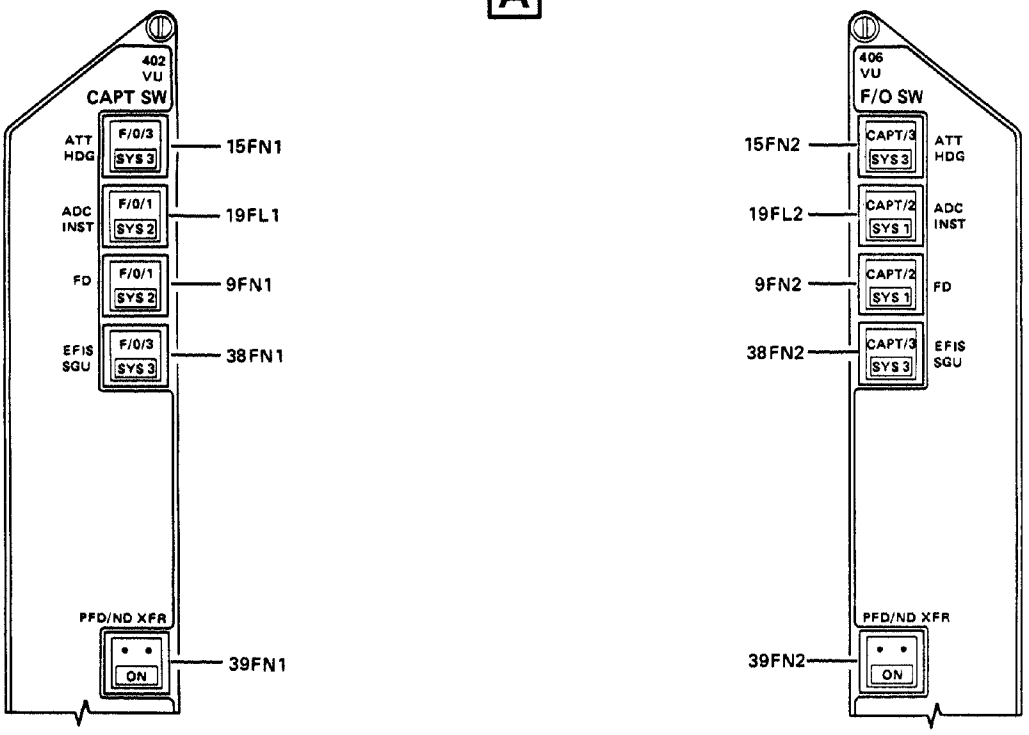
Electronic Instrument Display - Component Location, Sheet 1/3
Figure 001



Electronic Instrument Display - Component Location, Sheet 2/3
Figure 002





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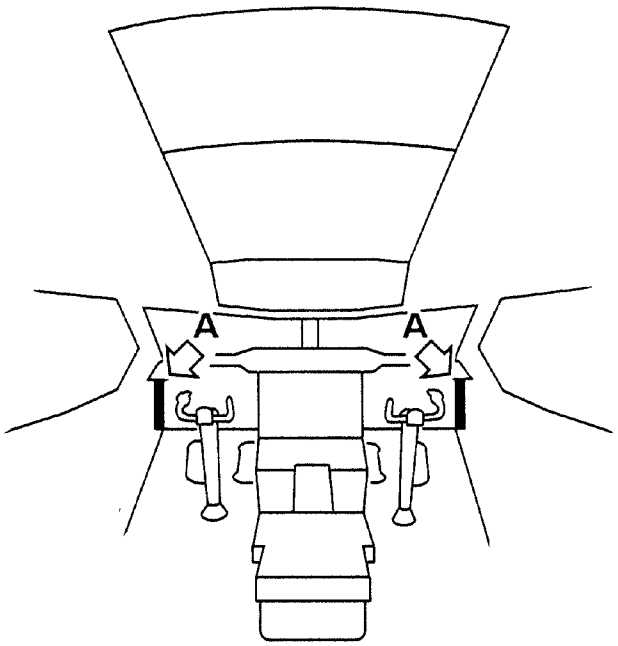
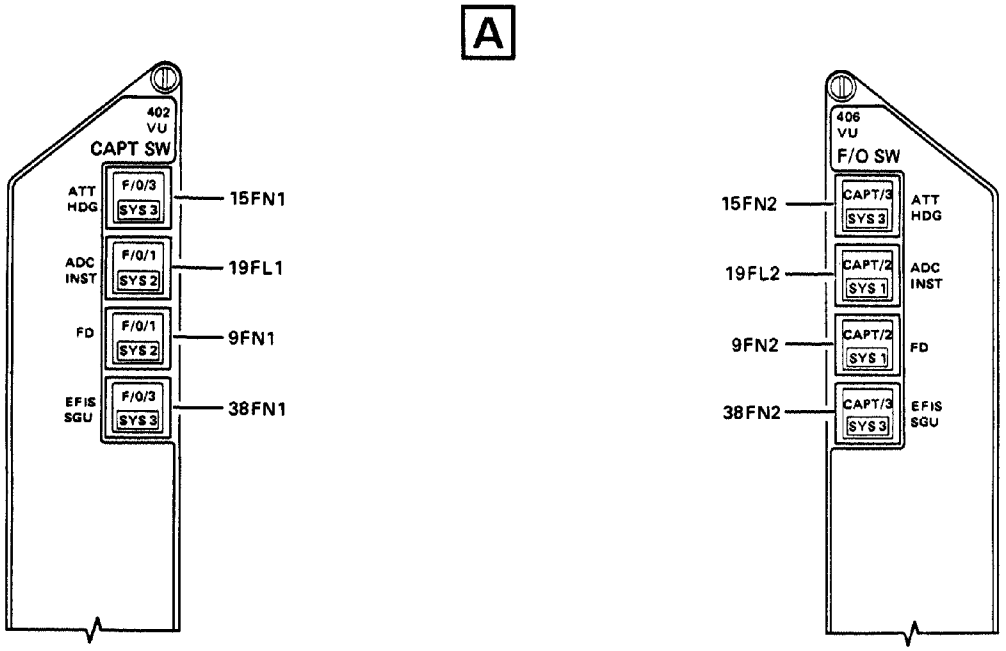
Electronic Instrument Display - Component Location, Sheet 3/3
Figure 003





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Electronic Instrument Display - Component Location, Sheet 3/3
Figure 004

3. Description

A. System Description

The architecture of the system enables the following capabilities :

- SGU1 drives the Captain's PFD and ND
- SGU2 drives the First Officer's PFD and ND
- both symbol generator units receive data from the associated input sensors
- SGU3 is able to replace either SGU1 or SGU2, therefore it receives data from all required input sensors
- control panels and complementary control panels enable selection of various display modes and brightness controls
- switching instrument panels allow certain configurations of input sensors
- pushbutton switches enable control of ground test sequences.

**ON A/C 001-100,

- PFD and ND images can appear on upper or lower display unit

**ON A/C 101-200,

- PFD image can appear on upper and lower display unit (by auto switching).

**ON A/C ALL

(Ref. Fig. 005)

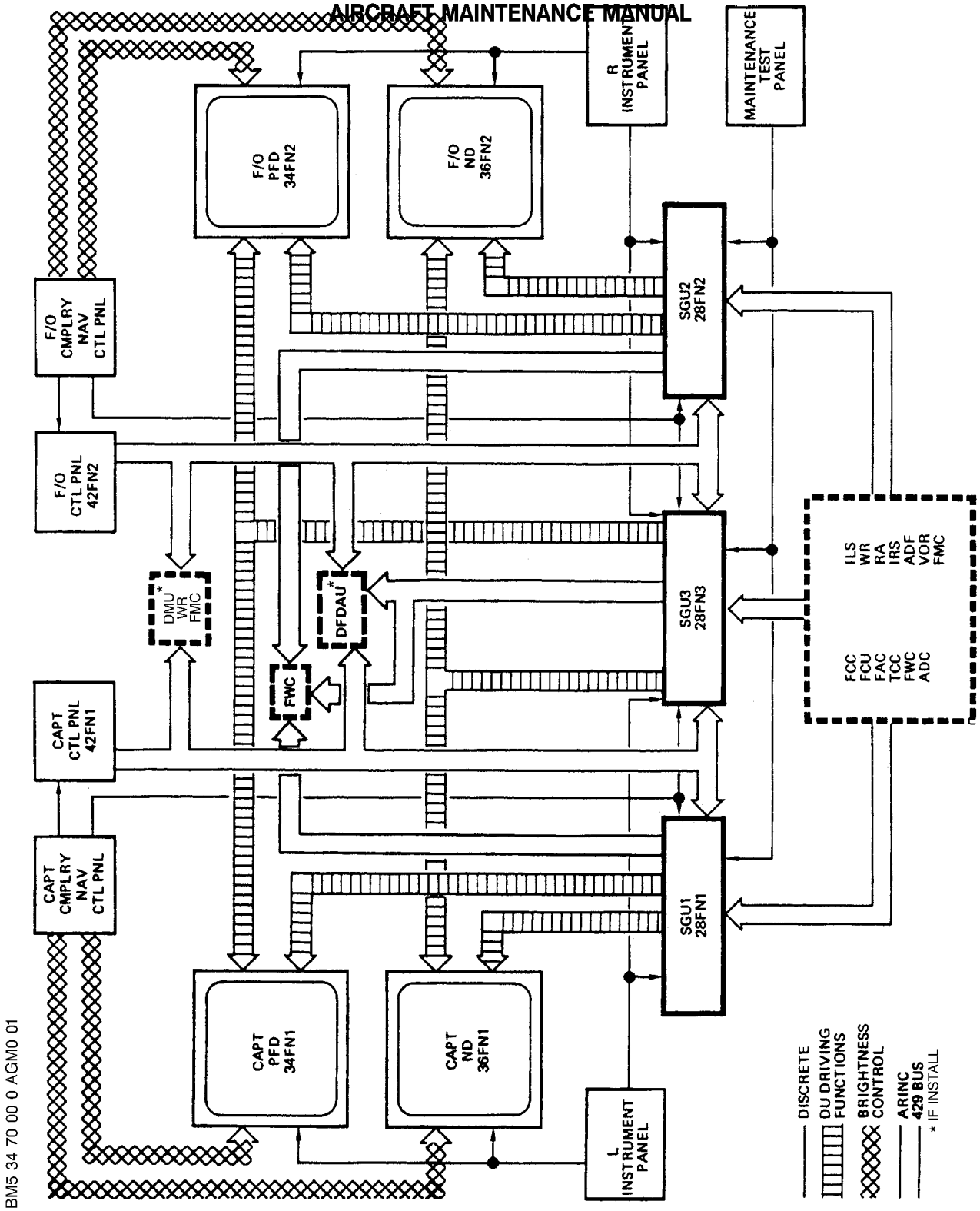
B. Power Supply

The display units and symbol generator units are supplied with aircraft 115VAC.

Captain's and First Officer's sides are supplied separately.

- Captain's equipment (SGU1, EFIS control panel 1, PFD1 and ND1) is supplied through essential bus bar 3XP.
  Nevertheless SGU1, PFD1 and control panel 1 can also be supplied through emergency bus bar and are therefore connected to emergency sub-bus 404XP through circuit breakers 30FN1, 35FN1 and 43FN1 respectively.
  ND1 is connected to essential sub-bus bar 301XP through circuit breaker 37FN1.
- First Officer's equipment is supplied from normal bus bar 205XP
  . through circuit breaker 30FN2 in the case of SGU2
  . through circuit breaker 35FN2 in the case of PFD2
  . through circuit breaker 37FN2 in the case of ND2
  . through circuit breaker 43FN2 in the case of EFIS control panel 2.
- SGU3 is supplied from normal sub-bus bar 105XP through circuit breaker 30FN3.

(Ref. Fig. 006)



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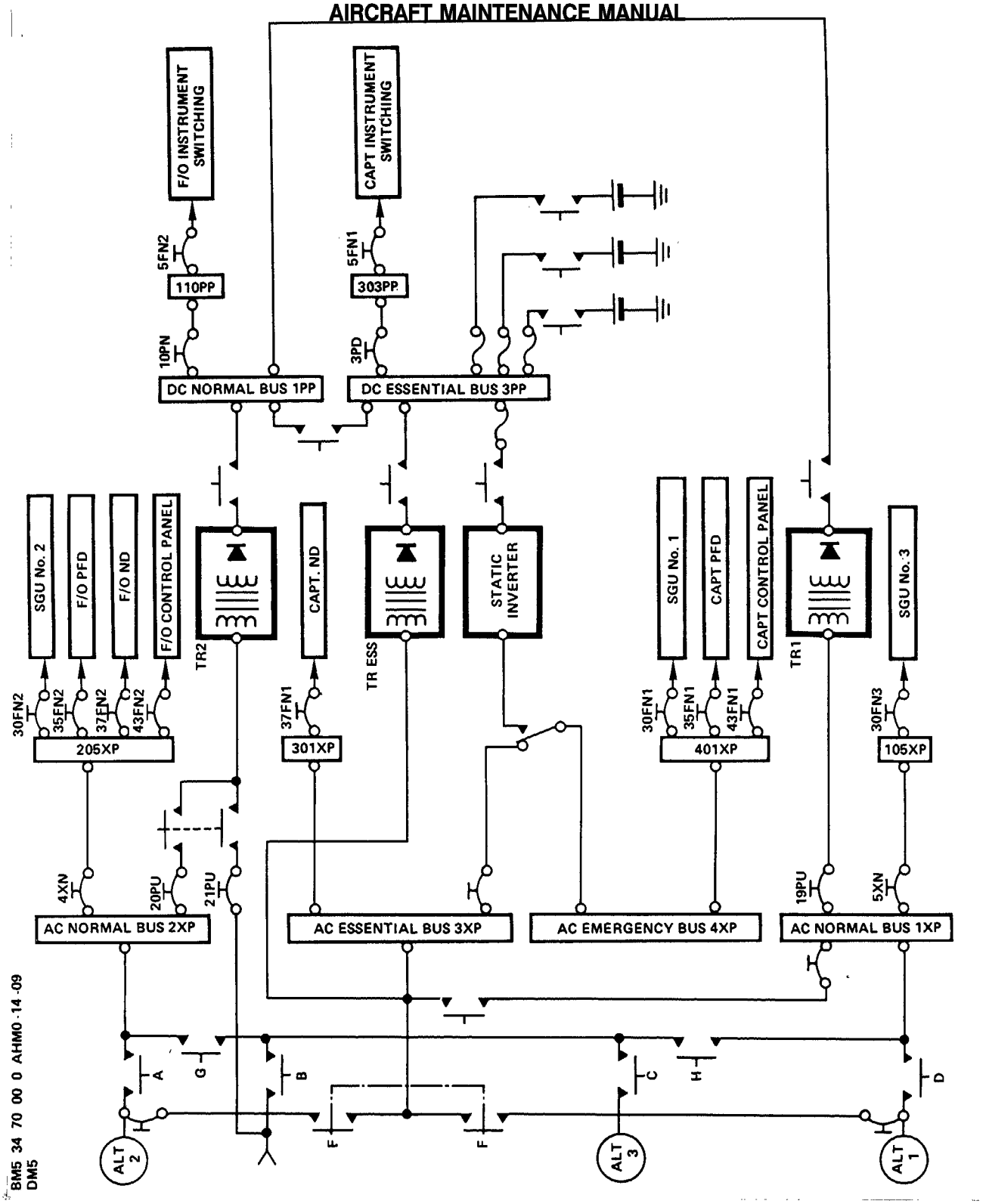
EFIS - Architecture
Figure 005



EFIS - Power Supply
Figure 006

4. Component Description

A. Symbol Generator Unit (SGUs : 28FN1, 28FN2, 28FN3)

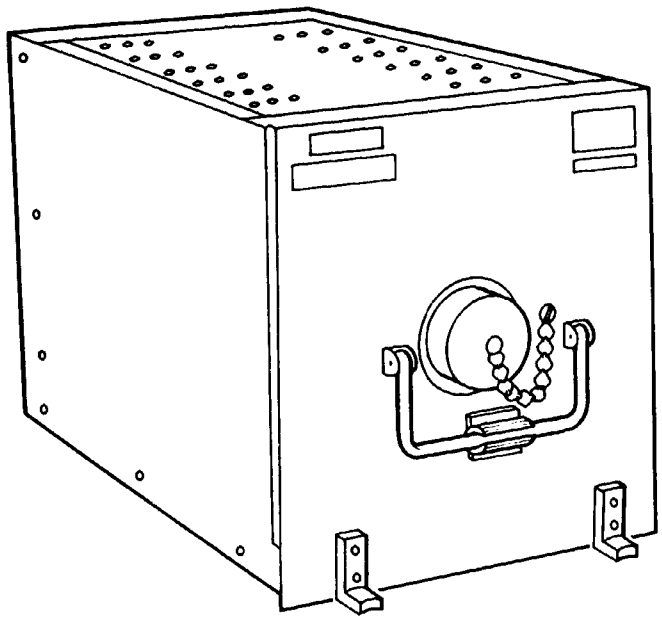
(1)Description
The SGU complies with the standards in ARINC specification 600. The unit contains hardware module boards vertically arranged to provide better air circulation. A double base has been provided in order to improve the cooling flow. It contains the ATE connector, the BITE indicator and the carrying handle. The elapsed time indicator is behind the front panel.

(2)Operation
The SGUs enable the acquisition and processing of various A/C system data.
They select the information for display on the display units considering the momentary crew requirements.

(a)Main characteristics

* Two independent processors
  - Display Management Processor (DMP)
  - Stroke Generator Processor (SGP).
* Different technology
  - DMP : TTL + TTL/LSI
  - SGP : TTL + NMOS/LSI.
* Different software
  - DMP : Emulation of INTERDATA 16
  - SGP : Specific application software.
* Worksharing
  - DMP : Operational treatment
  - SGP : Image writing.
* Mutual monitoring
  - Monitoring of program task completion
  - Monitoring of continuous data refreshing
  - Data feedback.
* Communication organization
  - Common memory : a 4 K RAX memory is used for data exchange
  - Passive members are included in the common memory address architecture
  - Active members can address the common RAX memory and passive members.
* Overall equipment control by DMP
  - ARINC 429 Automate
  - Discrete I/O Board
  - Weather Radar Board
  - Stroke Generator Processor
  - Raster Shading Unit
  - SGU Output Multiplexing
* Monitoring circuits
  - Watchdog timer
  - Power failure detection
  - Power supply overheat detection

(Ref. Fig. 007)



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EFIS - SGU
Figure 007

(b)Architecture (Ref. Fig. 008)

Data acquisition and processing, indication control and symbol generating are achieved via two independent processors and a set of dedicated interfaces. The functional layout of the SGU shows the equipment divided into the following sections

- Display Management Processor (DMP)
- Common RAX memory
- Stroke Generator Processor (SGP)
- Raster Shading Unit (RSU)
- SGU Output board
- Weather Radar board
- ARINC 429 Input board
- Discrete I/O and ARINC 429 Output board
- RAX bus access sequencer.

Display Management Processor

The DMP is used for the operational processing of the equipment data :

- interface control : ARINC Input board,
  Discrete I/O and
  ARINC Output board,
  SGU - Output board
  WR board.
- data management : data conversion,
  I/O formatting,
  image composition.
- control of the SGP : start/stop of the Stroke Generator Processor
- control of the RSU : Start/stop of the Raster Shading Unit

Stroke Generator Processor

The SGP traces the actually required image by generating the X and Y deflection signals and the color commands which are sent to the display units. It identifies the data blocks supplied by the DMP and traces the required subimages which build the final image. For dynamic image parts it uses the data composed by the DMP, for static image parts it uses data in its own PROM memories.

Common RAX memory

This memory is shared for data exchange between active RAX-bus controllers :

the DMP
the SGP
the ARINC 429 Automate
a test equipment (when connected to an ATE)

Their access to the RAX-bus and therefore access to the common memory or to other passive RAX-bus members :

the weather Radar board
the discrete I/O interface
the ARINC 429 output interface
the ARINC 429 input mode control
the Raster Shading Unit

is controlled by the RAX-bus access sequencers taking into account hard-wired priorities.

NOTE : The ARINC Automate has a write only access to a limited area within the RAX memory.

The weather radar board : is used to receive data from the ARINC 708 weather radar transceivers selected under DMP-control.
Control words are temporarily latched and can be read by the DMP through a passive RAX-coupler.
Weather radar image data is latched in a specific memory where it is accessible by the Raster Shading Unit.

The Raster Shading Unit : uses either data from the weather radar memories to generate a superimposed weather radar image on a navigation map display, or data from the DMP to display the pitch and roll angles on the PFD by Sky/ground shading.

SGU - Output interface
This interface takes the X and Y deflection and the color signals from the SGP and the RSU and transfers the data to the PFD and the ND.
Stroke generating on one DU and raster shading on the other DU is done during the same time.
Every 7.1 ms the DMP changes the position of the output multiplexers, thus enabling the alternate stroke and raster-writing on each display unit.

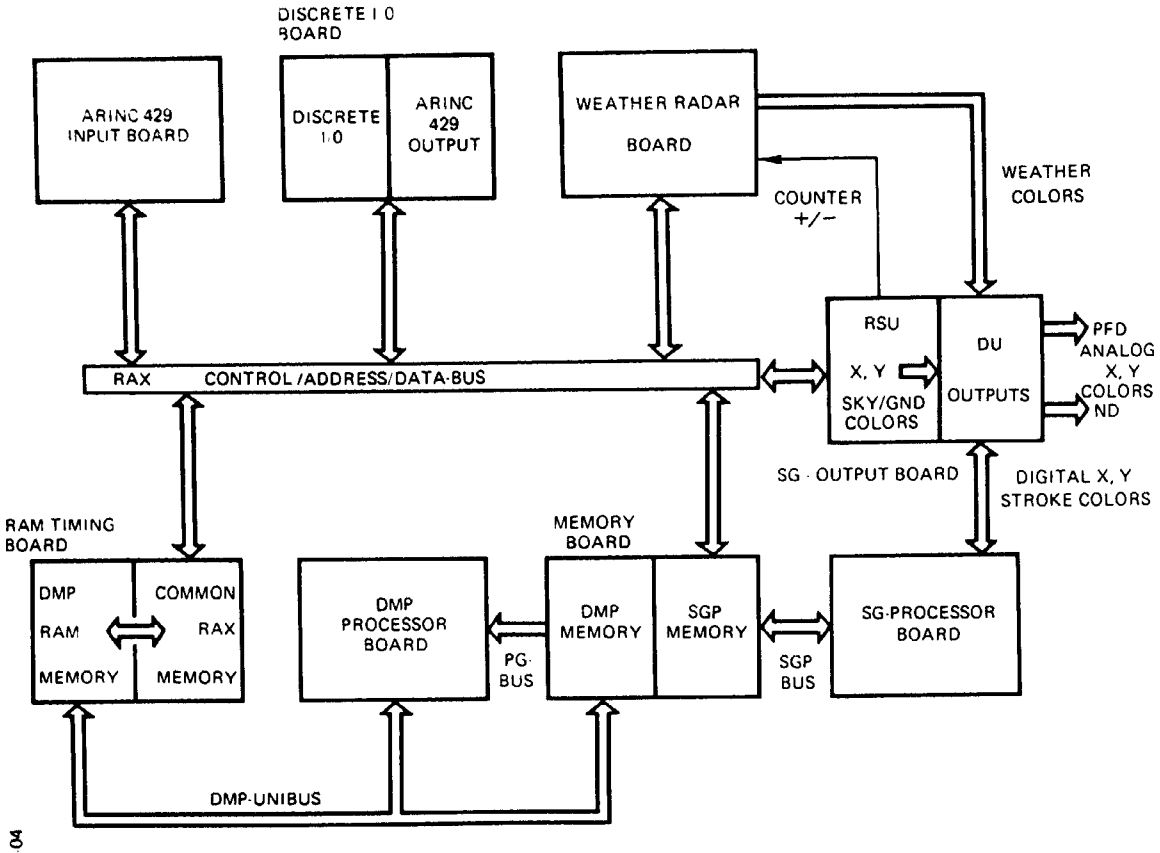
ARINC 429 input automate
This interface is used to receive data from ARINC 429 low speed and high speed buses.
Valid data is stored automatically in the RAX memory. After initialization or reconfiguration by the DMP 4 of 8 selectable high speed buses and 16 of 32 selectable low speed buses can be processed simultaneously.
Discrete I/O and ARINC 429 output interfaces
These interfaces use the same passive RAX coupler via which the DMP addresses
- 4 words of 16 bits input latches
- 2 words of 16 bits output latches
- 2 words of 16 bits which form the 32 bit ARINC shiftregister.

The ARINC 429 output interface can operate in three modes :
- low speed wrap around test
- high speed wrap around test
(test of the ARINC input automate)
- low speed output to other aircraft systems (e.g. ECAM, AIDs,...)

(c)Monitoring and testing
Each module within the application software includes monitoring parts.
In case of failure detection, the default process is called up.
Additionally modules are implemented to fulfill the safety objectives of the equipment :
- The power on test checks :
  - watchdog circuits
  - DMP program and data check-sum
  - interrupt circuits

- program control instructions (DMP CPU)
- input and output discrete interfaces
- RAM and RAX memories
- SGP drawing operations
- SGP program check-sum
- ARINC interface operation.

- The cyclic tests check the following equipment parts :
  - DMP - CPU
  - ARINC interface
  - RAX bus
  - input discrete interface
  - interrupt level 4 circuits.
- The feedback module serves mainly for the checking of critical parameters.
  For example :
  The position of the spot during drawing of the horizontal line is checked via the X/Y test register. The addresses of characters actually written on the display unit are checked via the A/N - address test register. The SGP monitor writes these values into the RAX memory where they are accessible by the feedback module. It compares these values with the values previously loaded from interface management modules and indicates a discrepancy to the programs concerned : (e.g. PFD image elaboration, ARINC output, default process).
- The watchdog process periodically triggers the watchdog circuits (every 5 ms).
  Additionally it takes into account the number of watchdog resets before the equipment is declared faulty and surveys the signatures of the operational module.
- The default process controls equipment failure detection and activates in some cases the bite process, to enable the subsequent failure identification.



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EFIS SGU - Architecture
Figure 008

B. Display Unit (34FN1, 34FN2, 36FN1, 36FN2)

(1)Description (Ref. Fig. 009)

The DU complies with the standards in ARINC specification 725.

The equipment is composed of the following mechanical elements :

- assembled structure
- very high voltage power supply (VHV)
- front face filter
- two lateral covers
- assembled cathode ray tube (CRT).

The DU is installed in a rack of the main instrument panel and the insertion/extraction device is in the form of a carrying handle.

Electrical connection to the aircraft by means of a connector and connection to the aircraft for the entry and exit of the cooling air are located at the rear of the DU.

(2)Operation

(a)General

The display unit, known as FCD 55 (Full color display with screen size of 5 x 5 inches), displays images generated by the SGU, using stroke scanning techniques. It is equipped with a shadow mask color cathode ray tube fitted with inline electron guns capable of generating polychrome images.

(b)Architecture (Ref. Fig. 010)

Each DU contains the following functional modules :

- low voltage power supply
- high voltage power supply
- assembled Cathode Ray Tube
- deflection system
- color processing and brightness controls.

Additional circuits for

- input monitoring
- test line generation
- tube protection

are placed on the different module boards where they are functionally needed.

1 Power supplies

A low voltage power supply generates :

- stabilized voltages for the analog and logic circuits
- filtered voltages for the deflection amplifiers for the high voltage and the filament voltages
- sinusoidal current which is sent to the demagnetization coil every time the unit is switched on.

All the critical voltages are checked and a status bit is generated in the event of excess voltage or of failure of any of these. A high voltage power supply generates all voltages necessary for the function of the cathode ray tube. A delay circuit provides a preheating of 30 seconds for the filament before the connection of the high voltage. An internal test circuit checks the operation of the high voltage and generates a status bit.

2 Assembled cathode ray tube

The shadow mask color CRT, the deflection coil, the converger, and the magnetic shielding are supplied as a complete assembly necessary to

the installation of the display unit.
The shadow mask tube consists essentially of a screen, a perforated mask with its frame and fastening springs, and of three electron guns assembled in the neck of the tube. These guns project three electron beams on the screen, controlled by the three beam signals, Red - Green - Blue.
The degaussing of the CRT is done with a coil surrounding the front part of the tube.
The front face consisting essentially of the filter and its support enables pilot's protection against an eventual tube implosion.
The filter which is made of neutral glass, is anti reflection treated.
A fiber optic is introduced at two points of the front face : it is used to measure the incoming light for the automatic brightness adjustment of the tube.

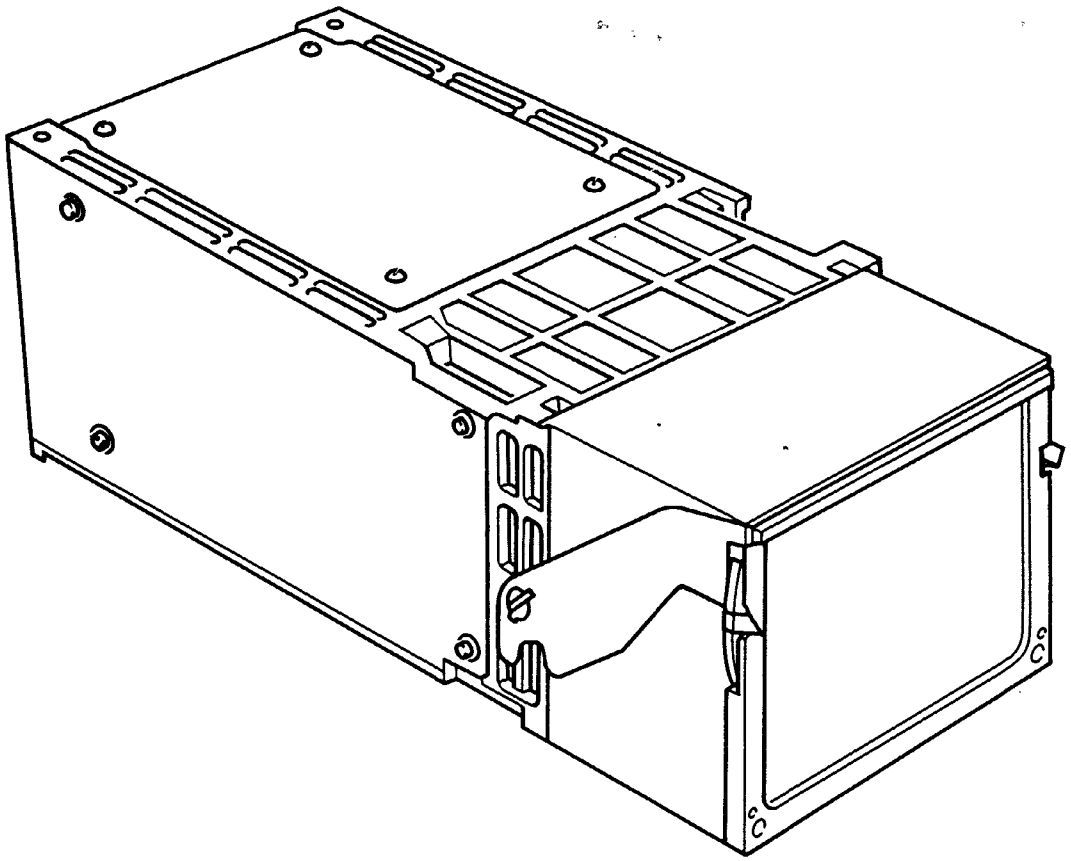
3 Deflection system
The deflection system processes the analog X and Y signals received from the symbol generator unit and provides the X and Y currents that, when applied to the deflection coil, enable the electron beam to be displaced.
The principal operations carried out by the deflection system are as follows :
- The deflection multiplexing of the signals coming from the normal SGU or the alternate SGU. A test circuit is selected, which draws a diagonal line across the screen, when the input monitoring discovers inactive or failed inputs.
- The geometrical corrections to eliminate pin cushion and linearity distortions.
- The deflection amplifiers control the X and Y deflection coils. They transform the deflection control voltages into currents.
- The orbiting allows to avoid the phosphor disturbance caused by repetitive drawing of the same synoptic and text on fixed screen areas. The centering of the image is slightly varied with time.

4 Color processing and brightness control
The five digital color bit signals from the two symbol generator units are multiplexed according to the state of the Normal/Alternate signal.
The manual brightness control signals for STROKE and RASTER modes arrive at different inputs.
Photocells are used to maintain a constant contrast on the screen. The information necessary for the color generating (color bits, brightness) is delivered in a code form corresponding to a specific current which will be injected into the associated cathode to obtain the desired color.

5 Input monitoring and test pattern generation
The incoming signals (X, Y and colors) are monitored after Normal/Alternate selection. In case of one or more static signals for a duration longer than 20 ms a line in 45° angle is drawn on the screen. When this line appears the DU is functioning. The SGU, the connection between the DU and the SGU, or eventually the receiving circuits could have failed.

6 Tube protection
In the event of a failure which could destroy the tube, the HV power

is disconnected and a discrete DU failure is sent to the symbol generator units.
When the temperature becomes too great inside of the unit, a temperature switch grounds the DU temperature signal, received by the SGUs.
It could be used to decrease the amount of data actually displayed, to decrease the refresh rate, or to stop the SGU output processing, depending on the specific requirements of this display unit.
A second level of temperature detection automatically interrupts the DUs operation.



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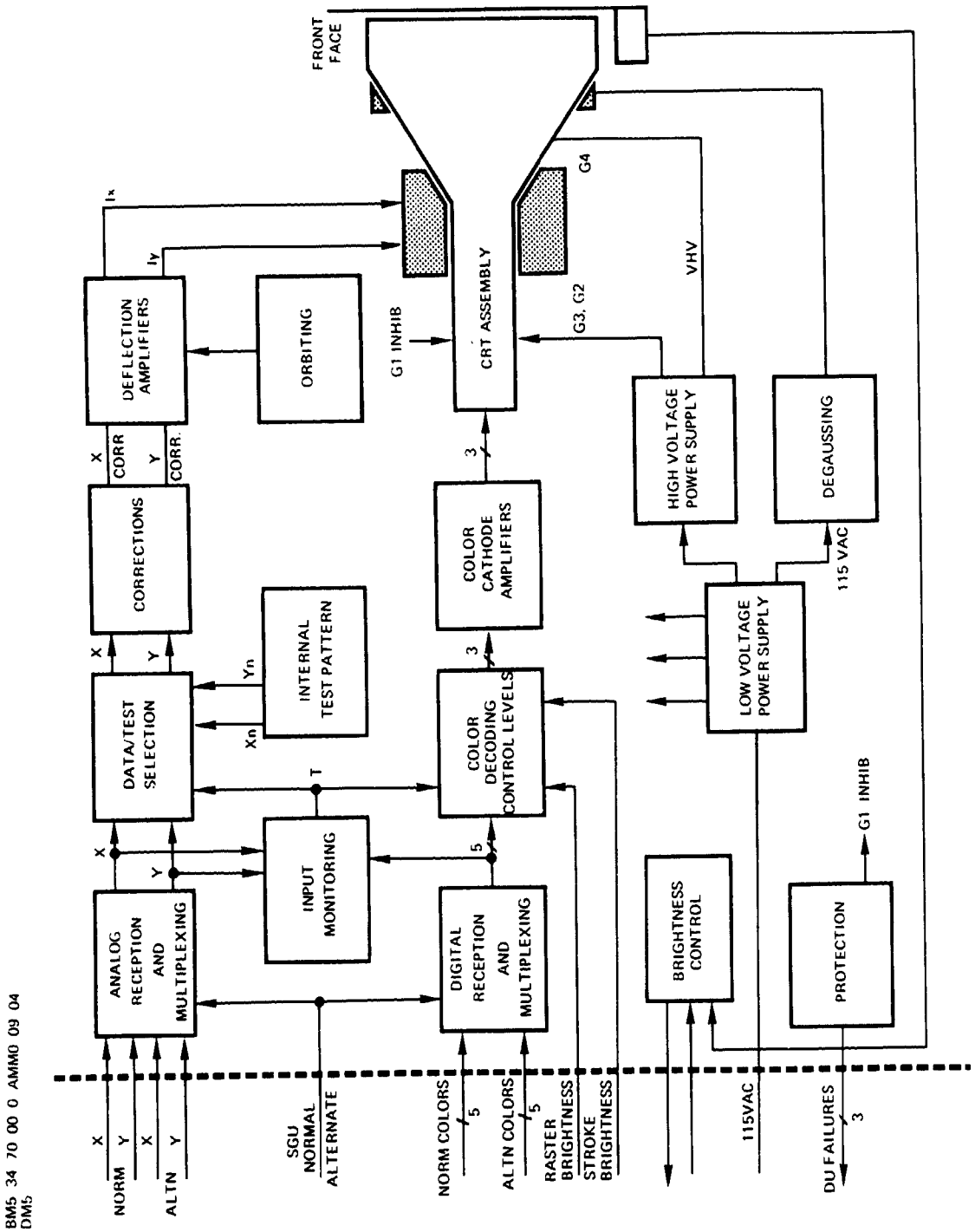
EFIS - Display Unit
Figure 009



DU - Block Diagram
Figure 010

C. EFIS Control Panel (42FN1, 42FN2)

(1)Description (Ref. Fig. 011)

DH and FPA pushbutton switches, pulse transmitting SET knob and the electronic display (LCD) are associated with the PFD, whereas CSTR, WPT, VOR.D, NDB, ARPT pushbutton switches and MODE and SCALE selector switches are associated with ND. All pushbutton switches have built-in lamps : selection is indicated by a strip coming on on the corresponding pushbutton switches. Pulse transmitting SET knob can be rotated endlessly in both directions. The electronic display is a 3-digit seven segment LCD. The MODE selector switch has five positions : TEST, ROSE, ARC, MAP and PLAN. The TEST position is only momentary and the switch returns to ROSE position when released. The SCALE selector switch also has five positions and selects one of the following radar ranges : 15, 30, 60, 120 and 240.

(2)Operation

The two panels are used as control and indication interfaces between the flight crew and the EFIS symbol generator units as well as some EFIS input sensors.

(a)Architecture (Ref. Fig. 012)

The switch settings and Discrete Input Signals are coded by the Processor Card into four ARINC 429 words. They are transmitted at a rate of 12.5 KHz (low speed) with a four bit gap separating the words. The transmitted words are simultaneously received and compared with the original data to prevent erroneous displays.

The equipments control is done with a CDP 1802 CMOS-Processor from RCA used with its associated I/O devices and CMOS memories. Changes related to functions can thus be made by changing the software (EPROMs) without altering the hardware.

(b)Controls

1 PFD controls

Pressing the DH (Decision Height) key sets the DH-value on the Display which can then be altered with the SET knob.

The value is adjustable in increments of 5 ft from - 5 to 995 ft. with an initial value of 0 ft.

Pressing the FPA (Flight Path Angle) key sets the FPA-value on the display, which is also alterable with the SET knob. The value is adjustable in increments of 0.1° from -9.9° to +9.9° with an initial value of 0°.

A further press of a selected key will deselect the function and set the display to : - - - which is also the initial display.

The SET knob rotates without limits in either direction.

2 ND controls

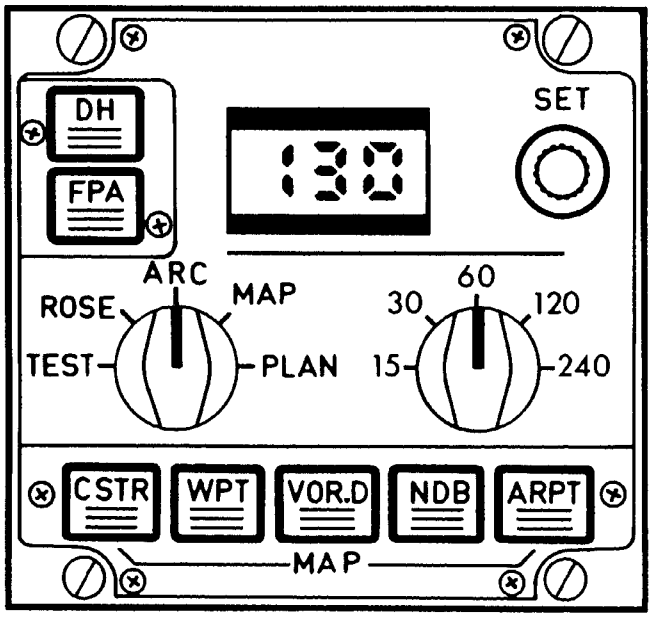
The SCALE switch allows to select one of five different ARC MAP or PLAN ranges.

The MODE switch allows to select four modes to present the navigation situation on the ND. A fifth position is used for test purposes (unstable state).

When MAP or PLAN mode is selected, options can be activated by pressing one of the five pushbutton switches located on the lower part of the panel.

Engagement of one pushbutton switch activates the indicated function,

illuminates the bar within the pushbutton switch and deselects the other functions.
A further engagement deselects the function and extinguishes the bar.
When the **MODE** switch is turned to **ROSE** or **ARC** position an option selection is kept but not active (bar extinguished). Turning the switch back to **MAP** or **PLAN** position reactivates the previously selected option (bar illuminated).



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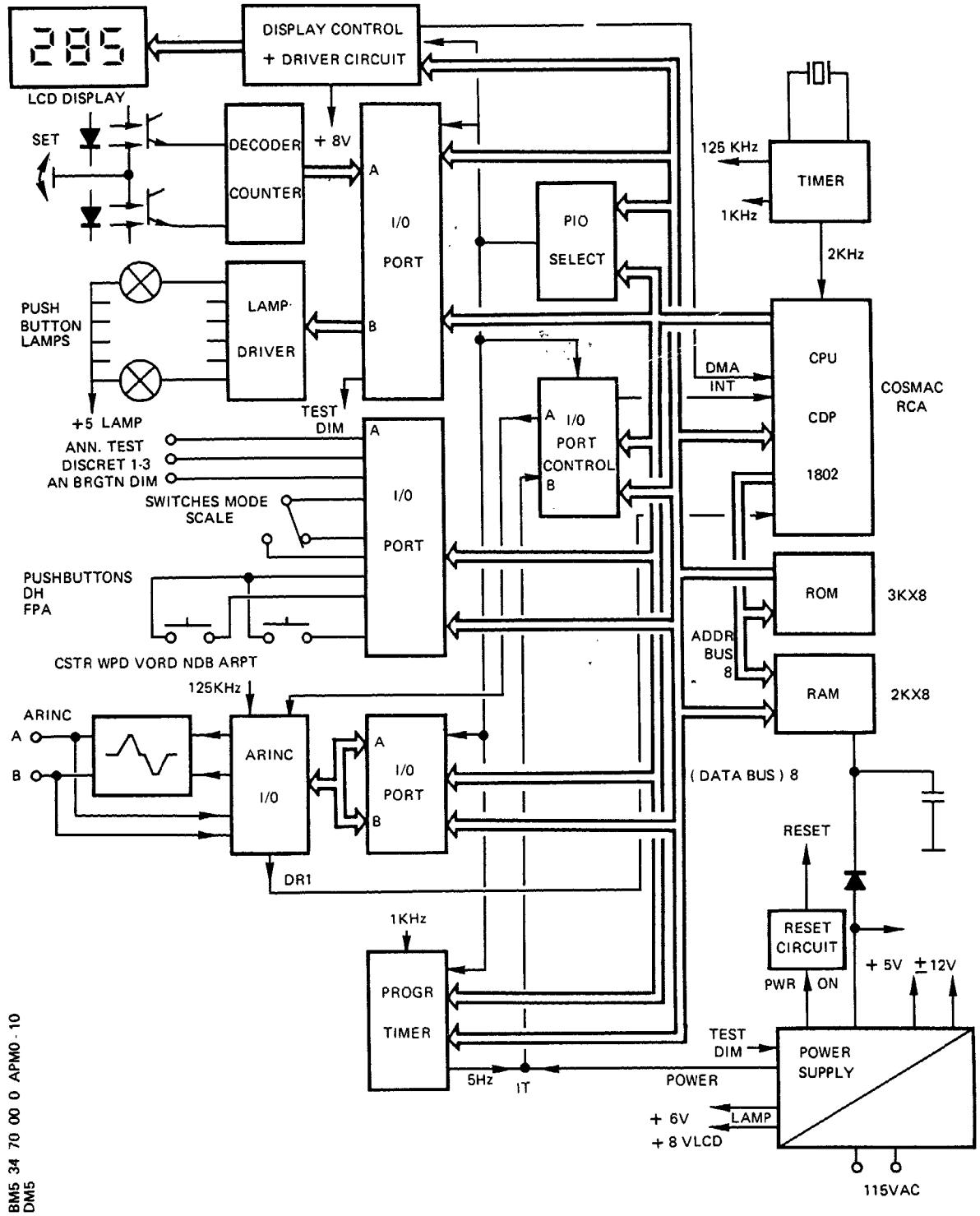
EFIS Control Panel
Figure 011



EFIS Control Panel - Block Diagram
Figure 012

D. Additional Panels

(1)Description

There are three types of additional panels :

- the two complementary control panels (located on CAPT side and F/O side of the two EFIS control panels)
- L and R instrument panels (located on CAPT and F/O extremities of the main instrument panel)
- the EFIS test panel, integrated in maintenance panel 47OVU.
  (see figures in para. 2. Component Location).

(2)Operation

(a)Complementary control panel

This panel includes the brightness potentiometers for the display units and two mode selector switches.

1 PFD brightness command

This potentiometer allows the manual brightness preselection for the PFD.

The signal is combined with the signal which measures the brightness on the front face filter of the DU and the signal coming from the remote light sensor located above the glareshield to enable the automatic brightness control. Turning the potentiometer to the OFF position switches off the upper DU. A PFD image will appear on the lower DU.

NOTE : In dark ambient condition, if the PFD OFF/BRT potentiometer is set to the lowest brightness level, faint lines can be displayed on the PFD. These faint lines can be removed by adjusting the brightness to a slightly higher level.

2 ND brightness command

The outer potentiometer allows the manual adjustment of TV scanning line brightness (master shading) on the ND.

The inner potentiometer allows the manual adjustment of stroke line brightness (stroke shading).

The combination with the circuits for automatic brightness control is the same as for the PFD. The ND can be switched off like the upper DU but with no effect on the PFD display.

3 FPV/FD switch

This is a three-position switch, which allows to select different types of display on the PFD.

In OFF position (stable) the guidance symbols are removed

- Flight Director (FD)
- Flight path symbols.

In ON position (stable) either the flight director or the flight path symbols are indicated, depending on the AFS modes.

The upper (instable) position allows to change the actual mode of guidance information : FD or FPV alternately.

4 VOR/NAV/ILS mode selector switch

This switch enables selection of course deviations on PFD and ND displays.

In VOR mode

- the PFD gives only the attitude deviation
- the ND gives the VOR deviation in Rose and Arc modes.

In NAV mode

- the PFD gives only the attitude deviation
- the ND gives no deviation in Rose and Arc modes.

In ILS mode
- the PFD and ND give the LOC and glide deviations.

**ON A/C 001-100,

(b)L and R instrument Panels
Each crew member has the possibility to reconfigurate his system by selection of standby equipment or sensors which normally supply the other crew member's system. In some cases the priority is given to the Captain's requirements.
PFD/ND XFR command : Additionally, on each panel, this command allows each crew member to transfer the PFD image to the lower DU and the ND image to the upper DU. Activating this command forces the associated symbol generator unit to alter the output channels to the display units.

**ON A/C 101-200,

(b)L and R instrument Panels
Each crew member has the possibility to reconfigurate his system by selection of standby equipment or sensors which normally supply the other crew member's system. In some cases the priority is given to the Captain's requirements.

**ON A/C ALL

The illumination of the other pushbutton switches indicates the following :
Upper part illuminated : the other crew member has already selected this system.
The lower part will be illuminated when the corresponding pushbutton switch is pressed to select the indicated system.

1 ATT/HDG (IRS switchover)
Both crew members can select switchover to IRS3, but not simultaneously : the Captain has priority, which means that if the First Officer is utilizing IRS3, the Captain can cancel this selection. The reverse is not possible.

2 ADC INST (ADC switchover)
The Captain can select switchover to ADC2/FAC2, but only if the First Officer has not already selected switchover to ADC1/FAC1. Reversely, the First Officer can select switchover to ADC1/FAC1, only if the Captain has not selected switchover to ADC2/FAC2 first.

3 FD (Flight Director switchover)
The Captain can select switchover to FD2 even if the First Officer has selected switchover to FD1 first.
Reversely, the First Officer can select switchover to FD1 even if the Captain has selected switchover to FD2 first.

4 EFIS SGU (selection of standby SGU 3)
Same restrictions as for IRS 3 selection.

5 Not applicable
6 Not applicable

(c) EFIS test panel

The three pushbutton switches located on the maintenance panel allow to start different equipment activities when the aircraft is not in flight conditions (aircraft on ground and ground speed less than 50 Kt).
Engagement of these pushbutton switches initiates the following functions :

- Display test (pushbutton switch common with ECAM system)
- Input test
- Bite display.

These functions are described in the following chapter.

5. Operation

A. General

(1)Choice of colors

The shadow mask technology provides great flexibility in the use of colors. The number of shades which are obtained by combination of the three primary colors (green, red, blue)is theoretically unlimited, but in order to make utilization easier, only a limited number of colors is used.

Therefore the EFIS uses seven different colors only, plus the shades which are specific to sky/ground shading.

These colors are :

- Red : it is used for failure warning messages display and flight envelope limits only.

- Green : it is used for active values display (for example : ground speed, track...).

- White : it is used mainly for scale display.

- Amber : it is used for display of information or warning messages which require particular attention or action from the pilot.

- Cyan (light blue) : it is used for display of all selectable values such as selected airspeed, armed mode, tuned navaids).

- Yellow : it is used for aircraft reference display (for example : aircraft symbol, heading line, zeros on deviation scales, etc...).

- Magenta (purple) : it is used for display of additional values (For example : constraints at waypoint, ADF markers, etc...).

The sky is shown blue.

The ground is shown brown.

(2)Data display format and location on the image

- The data display format is always the same whatever mode of operation is used :

  Ex : there is only one selected heading symbol whether in ROSE or in MAP mode.

- Each item of information is always displayed at the same place on the image :

  Ex : Vertical deviation is always displayed at the right part of the image.

(3)Sensor failure display

(a)The failure affects an item of information which is displayed on the DU in the actual mode of operation.

So as to avoid any confusion, this item of information disappears and is replaced by a red failure warning message which indicates clearly which information has disappeared.

The message flashes for a few seconds in order to draw the crew's attention, then remains visible as long as failure lasts, or until the

system is switched over to another source.
Moreover the failed item of equipment is indicated on the left **ECAM** display unit.

(b) The failure affects an item of information which is not yet displayed on the **DU** (For example : on **ILS** failure in **VOR** mode).
In this case, no failure warning message is displayed on the screen, but the failure information is transmitted to the **ECAM**, which indicates the failed item of equipment on the left **ECAM** display unit.

B. Operation on PFD

The PFD image is displayed on the upper display unit in normal operation and partly represents the basic T (Ref. Fig. 013).

It contains the following short-term primary flight data :

- attitude
- airspeed
- trajectory deviations
- radio height
- steering orders
- AFS mode indicator.

(1)Attitude data

(a)Sphere

The aircraft pitch and roll attitude is indicated in the center part of the image by a sphere which features the sphere of a conventional ADI (Ref. Fig. 014).

The displacement of the horizon line with respect to the aircraft symbol indicates pitch and roll angles.

The sky zone is colored blue. The earth zone is colored brown.

(b)Pitch Data

The pitch scale is white (Ref. Fig. 015). The most frequently used zone is graduated in 2.5° increments. The accuracy varies as a function of the operation range.

The areas where pitch is excessive are indicated by red V.

When pitch becomes greater than 25° (or lower than -13°), all the data displayed on the PFD other than attitude, speed and heading is cleared.

The image is normal again when the angle value becomes lower than 22° (or greater than -10°) again.

If IRS pitch data input is lost, the whole sphere is cleared and is replaced by a red ATT failure warning message which first flashes a few seconds. This failure warning message appears :

- in the event of failure of the source utilized.
- when EFIS internal monitoring detects an attitude failure.

When there is a difference of more than 4 degrees in pitch value between the two PPDs (between CAPT and F/O EFIS SGUs), a red CHECK ATT failure warning message is displayed on both PFDs. This message flashes for 9 seconds and then remains steady.

However the attitude data remains displayed.

The flight crew perform crosschecks using the standby instrument, for example.

**ON A/C ALL

R Each EFIS SGU compares the IRS pitch data input with the pitch data
R computed by the own EFIS SGU. When one EFIS SGU detects a discrepancy
R between these two pitch data several times in a given time, the red
R CHECK ATT failure warning message is displayed on the corresponding
R PFD. This message flashes for 9 seconds and then remains steady.

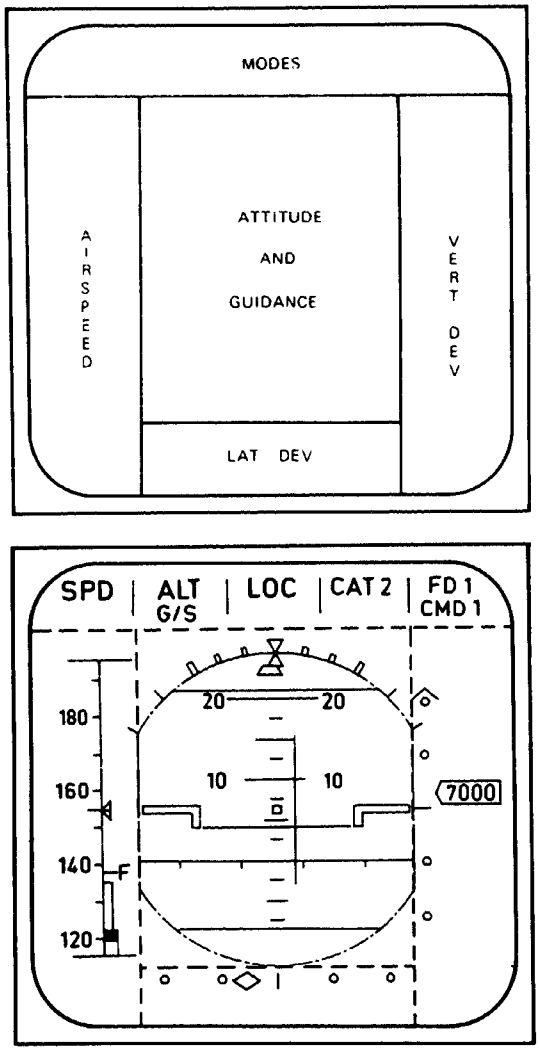
**ON A/C ALL

(c)Roll data
The roll scale is white, and is displayed above the sphere. It is graduated from -60° to +60°, with graduations at ±60°, ±45°, ±30°, ±20°, ±10°, 0° (Ref. Fig. 014).
The yellow roll index turns in relation to the roll angle, following the sphere outline. Sectors 1 and 2 turn simultaneously.
When roll becomes greater than 45°, all the PFD displays other than attitude and speed are cleared.
The image returns to normal when the roll angle becomes lower than 40° again.
A red ATT warning message appears when IRS roll data input is lost.
A red CHECK ATT message flashes for 9 seconds then remains steady when :
- there is a difference of more than 4 degrees in roll value between CAPT and F/O EFIS SGU
- the EFIS SGU detects a discrepancy between the IRS roll data input and the roll data computed by the own EFIS SGU.

(d)Cross track acceleration
Side slip is indicated by a yellow trapezoidal index which moves below the roll index (Ref. Fig. 014).
The displacement of these two indexes with respect to each other is proportional to the lateral acceleration : 1cm = 0.2g.
The side slip index is against stop beyond 0.30g, and so remains immobilized in the position which corresponds to this value.
It is cleared in case of failure.

**ON A/C ALL

(Ref. Fig. 016)



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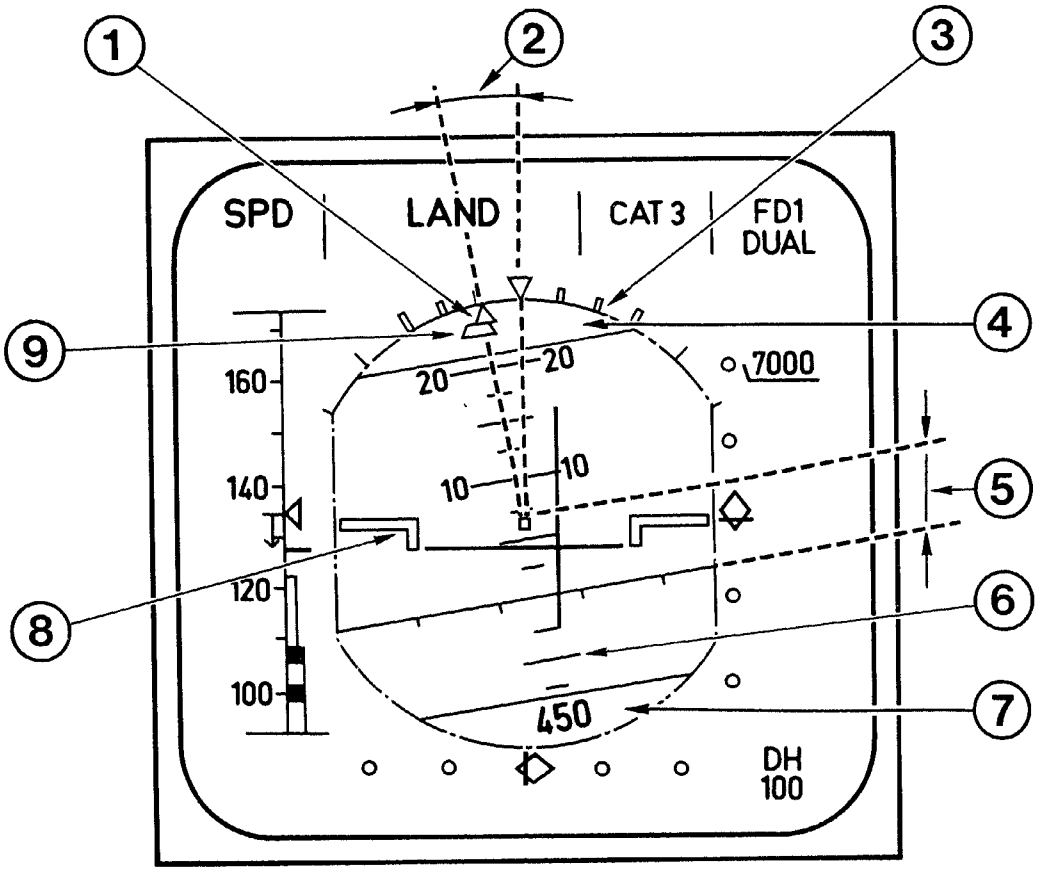
PFD Image - Basic T
Figure 013



1 - ROLL INDEX
2 - ROLL ANGLE
3 - ROLL SCALE
4 - SECTOR 1
5 - PITCH ANGLE
6 - PITCH SCALE
7 - SECTOR 2
8 - FIXED AIRCRAFT SYMBOL
9 - SIDE SLIP INDEX

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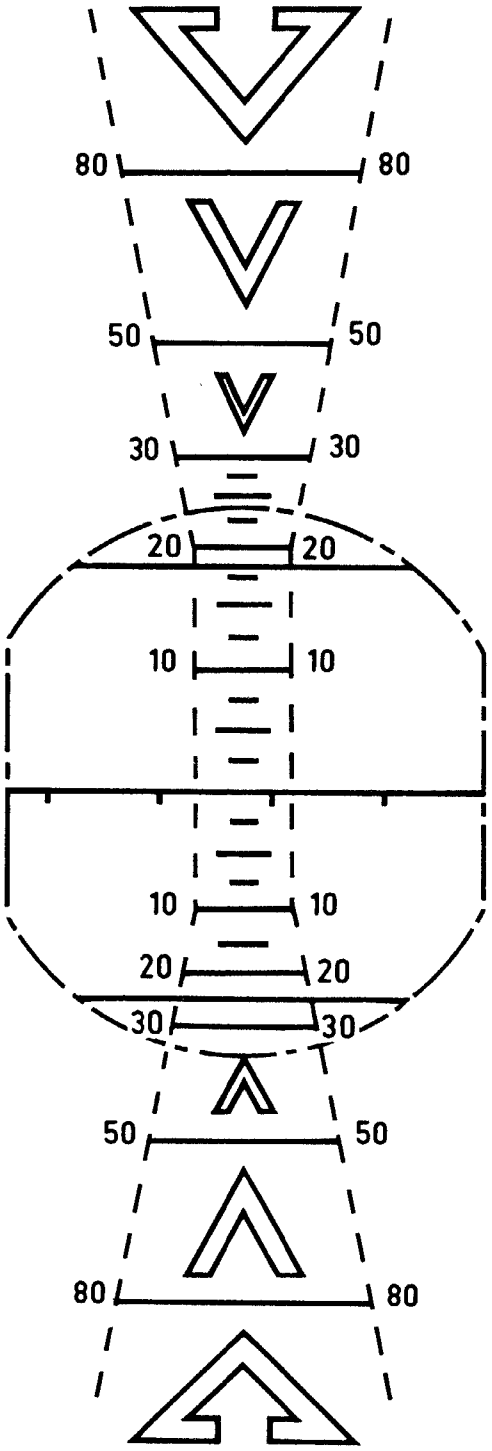
PFD - Attitude Display
Figure 014



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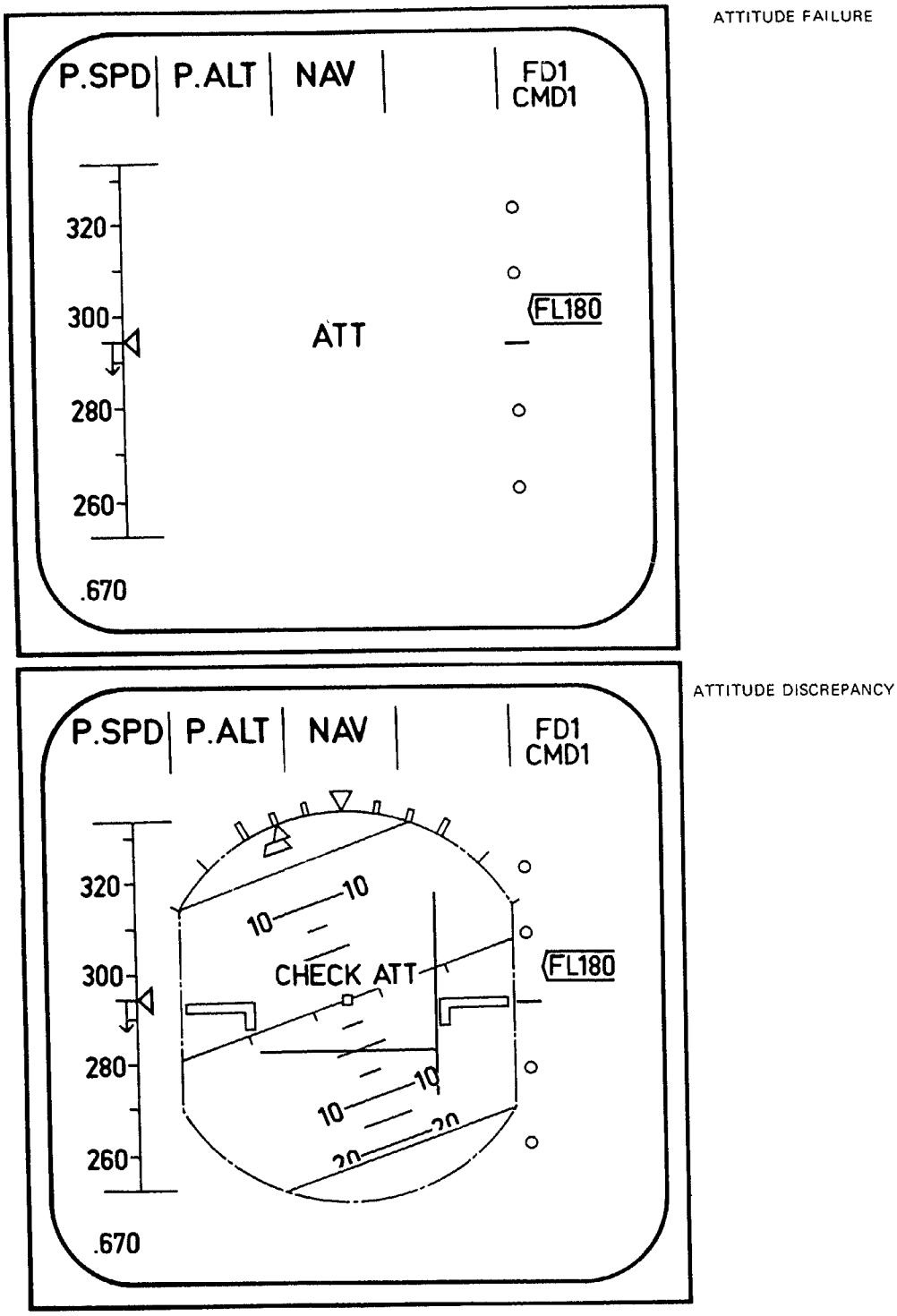
PFD - Pitch Scale
Figure 015



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PFD - Attitude Warning Messages
Figure 016

(2)Airspeed data

The airspeed scale, in the left part of the PFD contains all the airspeed data displayed by conventional airspeed indicators.

(a)Computed airspeed, Mach number, airspeed tendency (Ref. Fig. 017)

1 Computed airspeed Vc

The airspeed is indicated by a white scale which moves in front of the fixed computed airspeed symbol.

The scale factor is 1mm per knot, which enables display of an 80 knot range.

As Vc minimum value provided by the ADC is 30 knots, the scale remains fixed when Vc is less than 30 knots, which is the case when the aircraft is immobilized. In this case a half scale only is displayed to indicate that the scale is against stop. The second half of the scale will be displayed progressively as Vc becomes greater than 30 knots.

In the case of airspeed data failure, all the symbols displayed on the scale are cleared, the scale turns red and a red SPD failure warning message which flashes a few seconds is displayed (Ref. Fig. 017). In this case, the airspeed information is obtained by switching over to the other ADC.

2 Mach number

The Mach number corresponding to the airspeed is displayed in white below the airspeed scale. It is displayed for all values greater than 0.50, and is cleared for values lower than 0.45.

3 Airspeed tendency ΔVc

The airspeed tendency : acceleration or deceleration is indicated by a yellow pointer initiating in the computed airspeed symbol.

The limit of the vector gives the airspeed value which will be attained in 10 seconds if the acceleration remains constant.

This vector appears only above a threshold greater than 2kt and is cleared for values lower than 1kt.

This hysteresis avoids flashing around the threshold. In the event of a FAC failure, this acceleration symbol is cleared.

(b)Limit airspeeds (Ref. Fig. 017)

1 Minimum selectable speed (Vms)

It is represented by an amber strip against the airspeed scale.

It varies as a function of altitude and present configuration :

- in altitudes lower than 25,000 ft., it represents :
  . 1.2 Vs on ground then at takeoff
  . 1.3 Vs as soon as flap and slat control lever is actuated and up to landing
- in altitudes greater than 25,000 ft., it gives a margin of 0.3g. with respect to buffeting.

This item of information is inhibited at takeoff up to five seconds after closure of landing gear shock absorber relay contact.

2 Stick shaker speed (Vss)

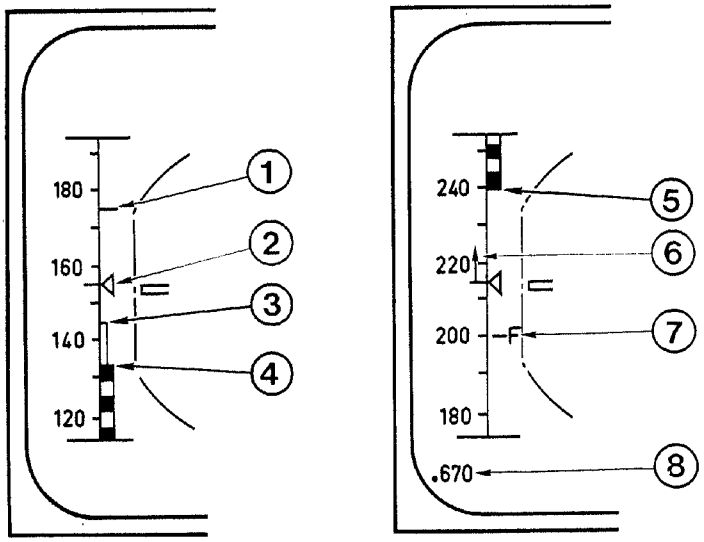
The speed at which the stick shaker is activated is represented by a red and black checkered tape.

This speed is dependent on the present configuration and the load factor.

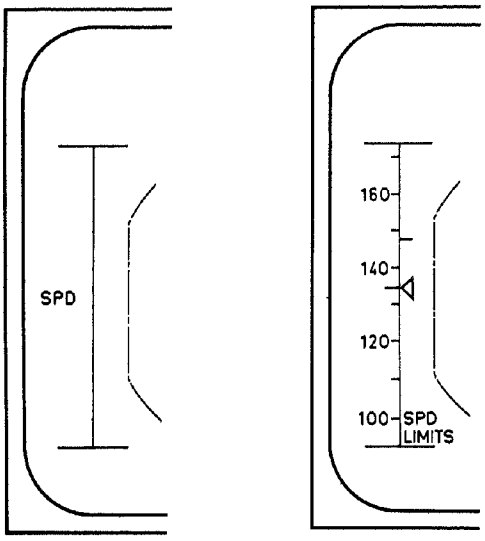
This item of information is inhibited at take-off up to five seconds after closure of landing gear shock absorber relay contact.

3 Maximum allowable airspeed (Vmax)
It is represented by a red and black checkered tape.
. For slats retracted and landing gear retracted : Vmax = VMO.
VMO takes account of MMO which is converted into speed as a function of altitude.
. For slats retracted and landing gear extended :
Vmax = VLE (maximum allowable speed with the landing gear extended)
. For slats extended :
Vmax = VFE (maximum slat or flap extension speed).

4 Failure display
All the limit speeds mentioned in the preceding paragraphs are computed by the FAC.
In the case of FAC failure these speeds are no longer available, therefore no longer displayed. A SPD LIM failure warning message is displayed at the bottom of the airspeed scale (Ref. Fig. 017).



1 . SELECTED AIRSPEED INDEX
2 . FIXED COMPUTED AIRSPEED SYMBOL
3 . MINIMUM SELECTABLE AIRSPEED STRIP
4 . MINIMUM AIRSPEED TAPE (STICK SHAKER AIRSPEED)
5 . MAXIMUM ALLOWABLE AIRSPEED TAPE
6 . AIRSPEED TENDENCY POINTER
7 . MANEUVER AIRSPEED
8 . MACH NUMBER



AIRSPEED DATA FAILURE FAC FAILURE

BM5 34 70 00 0 ABP0 00

PFD - Airspeed Display and Failure Messages
Figure 017

(c)Maneuver Speeds (Ref. Fig. 018)

The airspeed scale provides the crew with data concerning the normal and the critical flap and slat retraction and extension speeds, that is V1, V3, V4 and Vm.

1 V1 : Decision Speed

It is loaded by the FMC CDU, and is clearly spelt out near the airspeed scale or displayed in the form of a cyan symbol -1 when this is allowed by the zone displayed. The symbol is cleared at takeoff. In case of failure, a red V1/INOP warning message replaces the numerical value.

2 V3

This is the minimum flap retraction speed. It corresponds to 1.25Vs in slats 15°/flaps 0° configuration.

It is represented by a green -F symbol which moves along the airspeed scale. The latter is therefore visible only when V3 lies in the zone displayed.

The flaps can be retracted when Vc is greater than V3, that is when -F symbol lies below Vc symbol.

-F symbol is displayed in slats 15°/flaps 15° and slats 20°/flaps 20° configurations only. It is inhibited at takeoff up to five seconds after closure of landing gear shock absorber relay contact.

3 V4

It is the minimum slat retraction speed. It corresponds to 1.25Vs in clean configuration. It is represented by a green -S symbol which moves along the airspeed scale. The latter is therefore visible only when V4 lies in the zone displayed (Vc - 40 ≤ V4 ≤ Vc + 40).

The slats can be retracted when Vc is greater than V4, that is when -S symbol lies below Vc symbol.

-S symbol is displayed in slats 15°/flaps 0° configuration only and at takeoff five seconds after closure of landing gear shock absorber relay contact.

4 Vman

Vman is the optimal maneuver speed in the present configuration :

- Below 10000 ft :
  Vman = 1.45 Vs
- Above 10000 ft :
  Vman = optimal speed to hold the best lift/drag ratio.
- This speed is displayed when the aircraft is in clean configuration only.

5 Failure display

The maneuver speeds mentioned in the preceding paragraphs, (except V1) are computed by the FAC.

In case of FAC failure SPD LIM failure warning message is displayed (Ref. Fig. 017).

(d)Target speed Vselect (Ref. Fig. 019)

The target speed is :

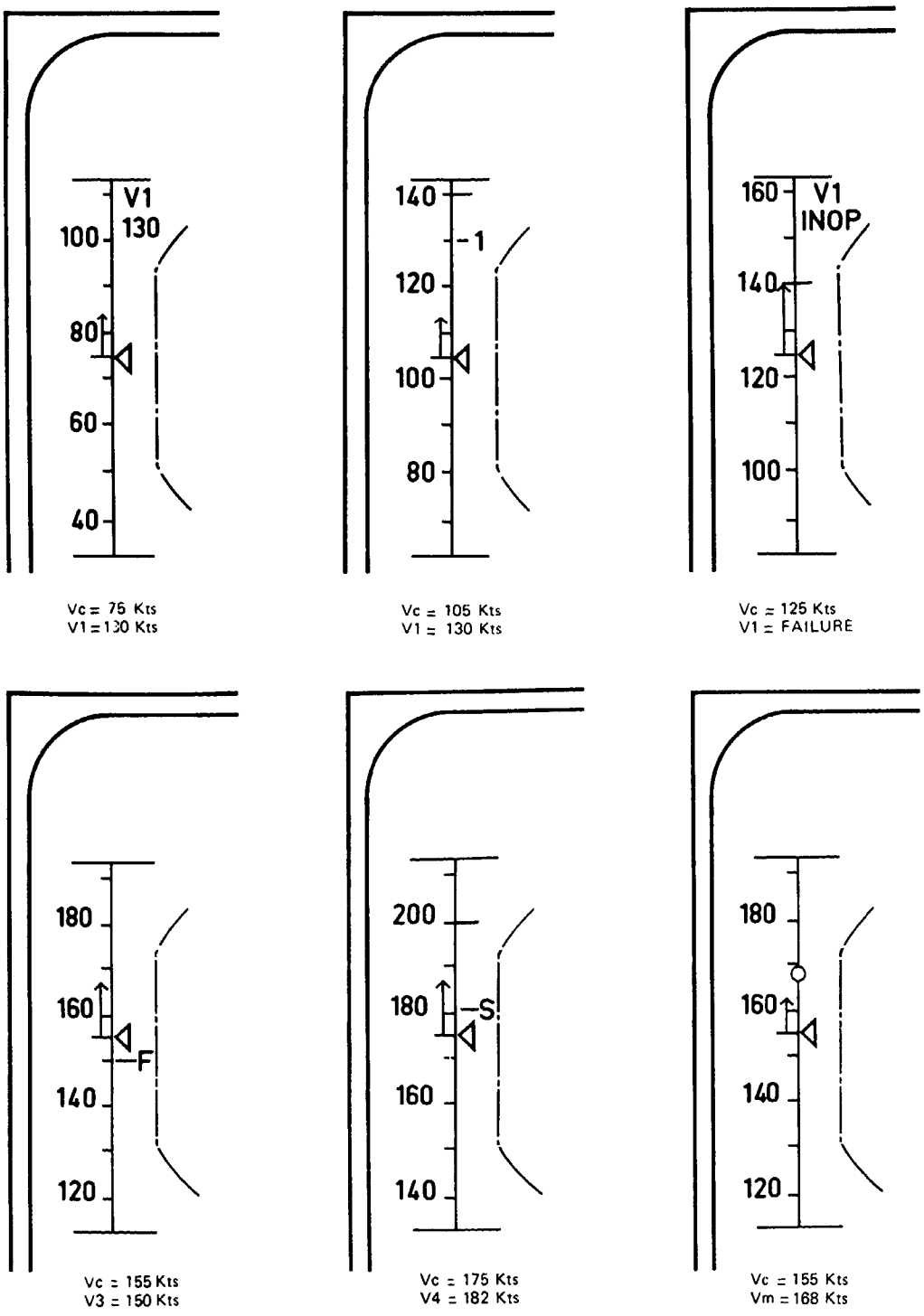
- either the speed displayed on the FCU
- or the FMC target speed when PROFILE mode is engaged.

It is represented by a cyan index when it lies within the displayed section of the airspeed scale, or by its digital value when it lies out of the scale.

This digital value is displayed above the airspeed scale if Vselect is greater than Vc +40 kts, or below the scale if Vselect is lower than Vc - 40 kts.

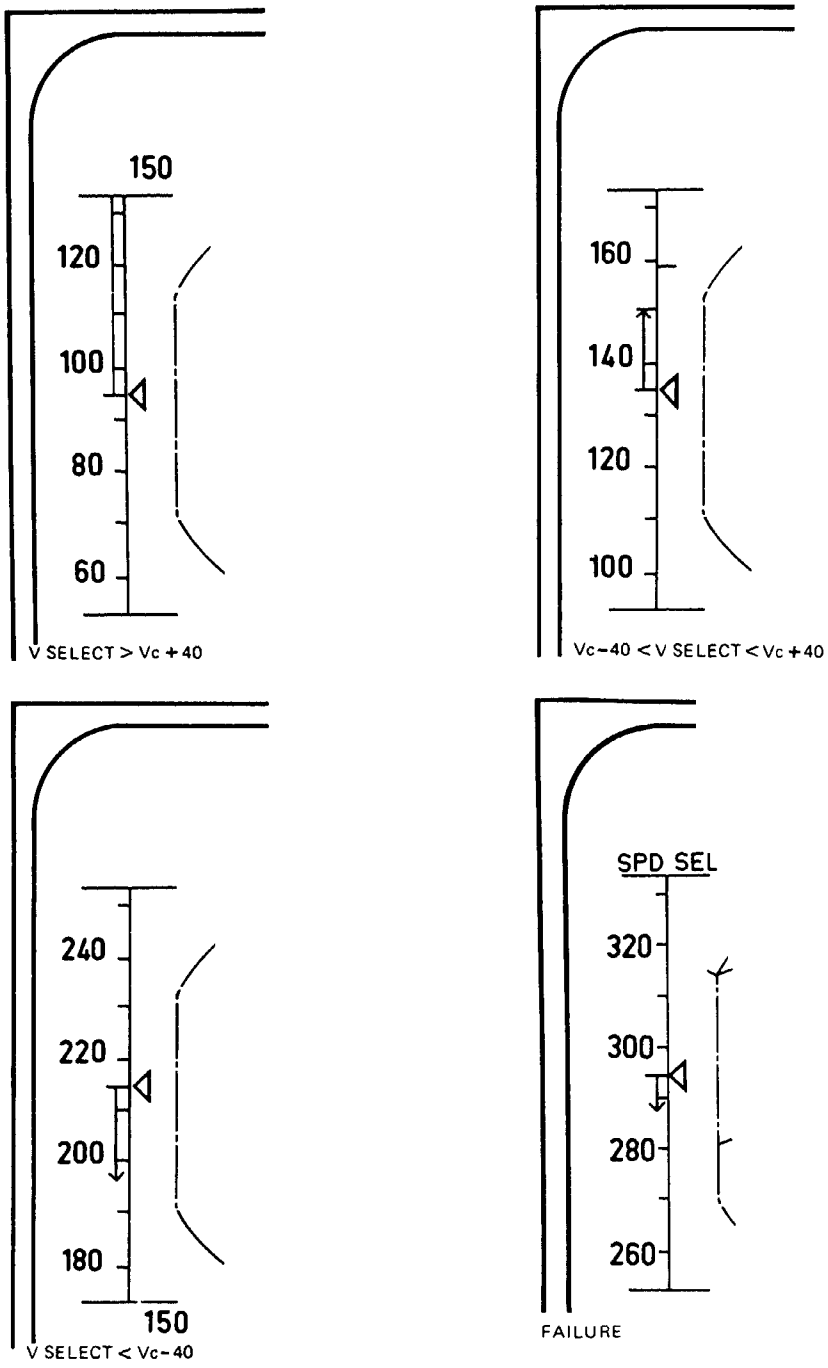
In the event of failure, the SPD SEL failure warning message is displayed in red above the scale and it flashes a few seconds.

(e)Not applicable



8M5 34 70 00 0 ADPD 09 04
DM5

PFD - Maneuver Speeds
Figure 018



BM5 34 70 00 AEPD 09 04
DM5

PFD - Vselect Display
Figure 019

(3)Trajectory deviations

The deviations displayed on the scales located in the right and lower sections of the **PFD** depend on the position of **VOR/NAV/ILS** mode selector switch located on the complementary control panel.

When in **VOR** or **NAV** mode with **LAND** mode armed or engaged, an amber flashing **ILS** message is displayed in the lower lefthand section of the sphere to remind the pilots to switch to **ILS** mode (Ref. Fig. 020).

(a)**VOR** or **NAV** mode

1 Lateral deviation

The lateral deviation is not displayed in these modes.

2 Vertical deviation

When **VOR/NAV/ILS** mode selector switch is in **VOR** or **NAV** position, the scale on the righthand part of the **PFD** displays an altitude error with respect to the altitude selected on the **FCU**.

The altitude selected is displayed in cyan in the mobile index, either in feet or in flight levels, depending on the position of **BARO** set knob located on the altimeter.

Pressing the knob gives the baro corrected altitude in feet (Ref. Fig. 021) (Part A). Pulling it gives the standard flight level (Ref. Fig. 021) (Part B).

The deviation between two dots represents a height of 500 feet. In the following figure, the aircraft is at about 500 feet above the selected altitude which is 7000 feet.

The maximum deviation displayed is 1000 feet. Beyond this value, the index is against stop and only half of it is represented (Ref. Fig. 021) (Part C).

In case of loss of altitude selected or aircraft altitude, the index is cleared (Ref. Fig. 021) (Part D).

(b)ILS Mode

1 LOC deviation

The lateral deviation scale presents a normal LOC deviation.

The LOC deviation index is magenta, the scale is white (Ref. Fig. 022) (Part A).

The maximum deviation displayed is ± 0.155 ddm or 150 μA, (2 dots). Beyond this value, the index is against stop, and only half of it is represented (Ref. Fig. 022) (Part B).

In the case of excessive deviation alarm, the index and the scale flash.

In the case of LOC information failure, the index is cleared and a red LOC failure warning message which flashes a few seconds is displayed in the middle of the scale (Ref. Fig. 022) (Part C)

NOTE : In case of no computed data (ILS data not received, for example), the index is not presented, and no failure warning message is displayed (Ref. Fig. 022) (Part D).

2 Vertical deviation

In addition to altitude error, the vertical deviation scale presents a normal glide slope deviation (Ref. Fig. 023) (Part A).

Both indexes move along the scale simultaneously (Ref. Fig. 023) (Part B).

A two-dot glide slope deviation represents 0.175 ddm (or 150 μA).

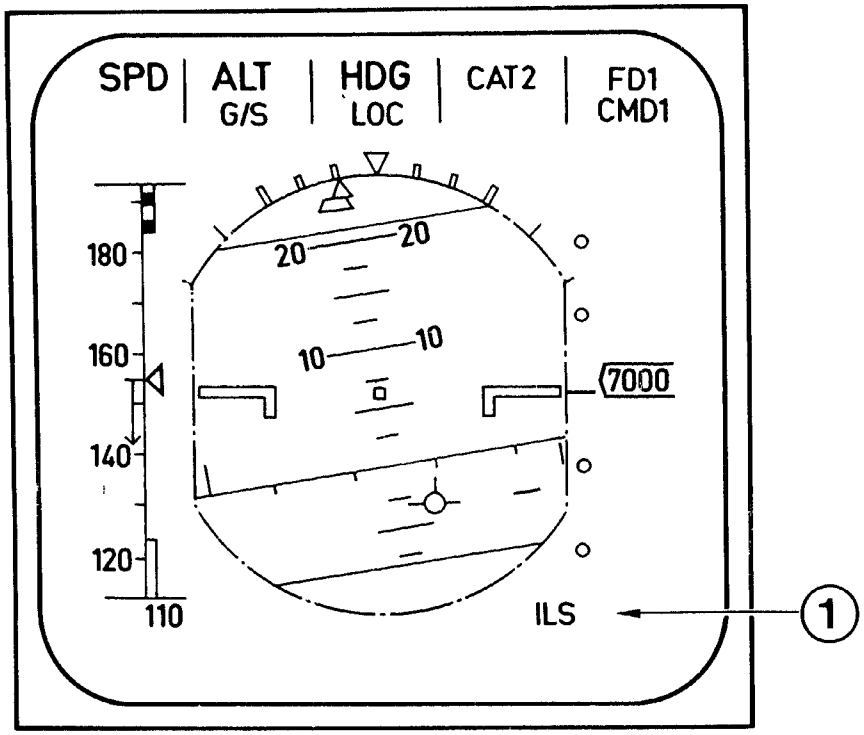
The limit of G/S index is on the second dot.

In the case of excessive deviation alarm, the index and the scale flash. In the case of glide slope failure, G/S index is cleared and a red G/S failure warning message which first flashes for a few seconds is displayed on the top of the scale (Ref. Fig. 023) (Part C.

NOTE : In case of no computed data (ILS data not received for example), the index is not represented and the failure warning message is not displayed.

(c)DME associated with ILS

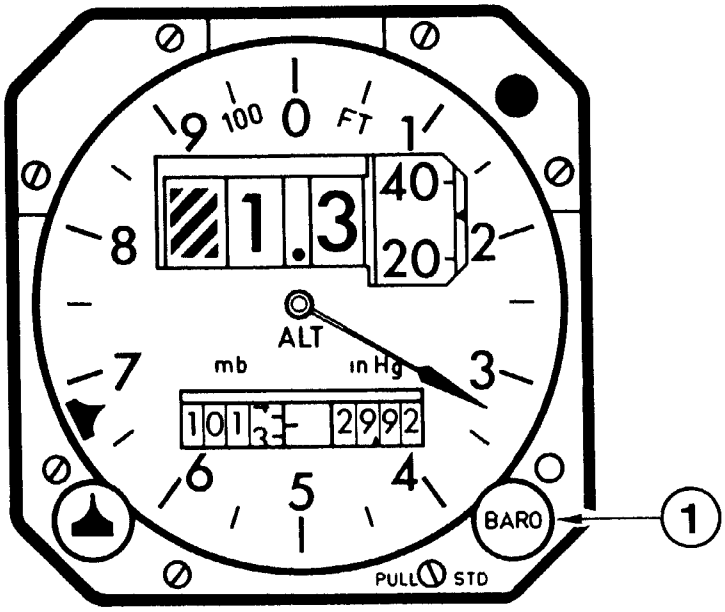
When a DME marker is associated with the ILS selected, the corresponding distance is displayed on the PFD, in ILS mode only.
This distance is displayed in green below the airspeed scale, instead of Mach number when the latter is not displayed.
(Ref. Fig. 024)

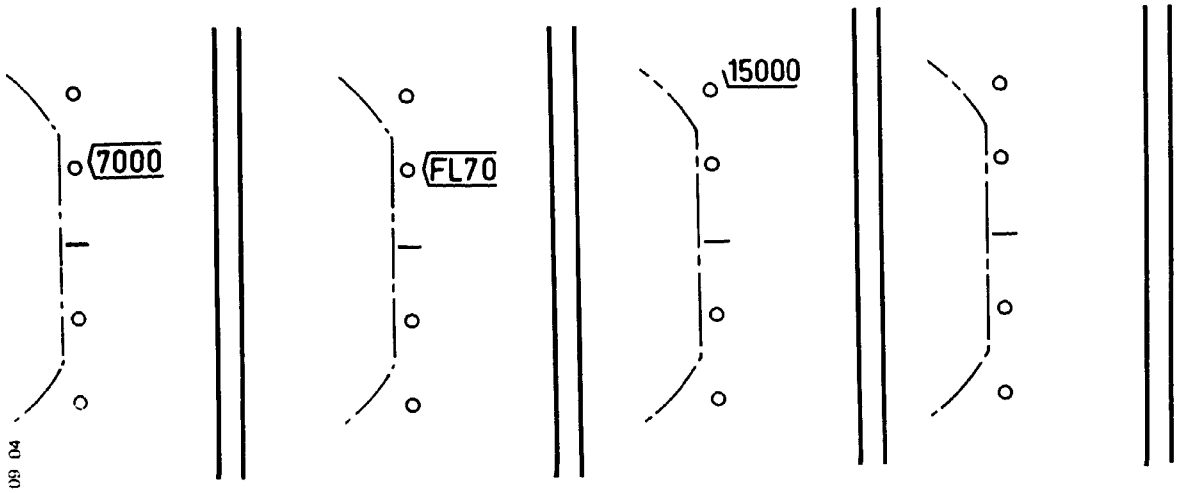


1 - ILS REMINDER

BM5 34 70 00 0 AGP0 09 04
DM5

PFD - VOR or NAV Mode with Land Mode engaged
Figure 020





A) BARO CORRECTED ALTITUDE

B) STANDARD FLIGHT LEVEL

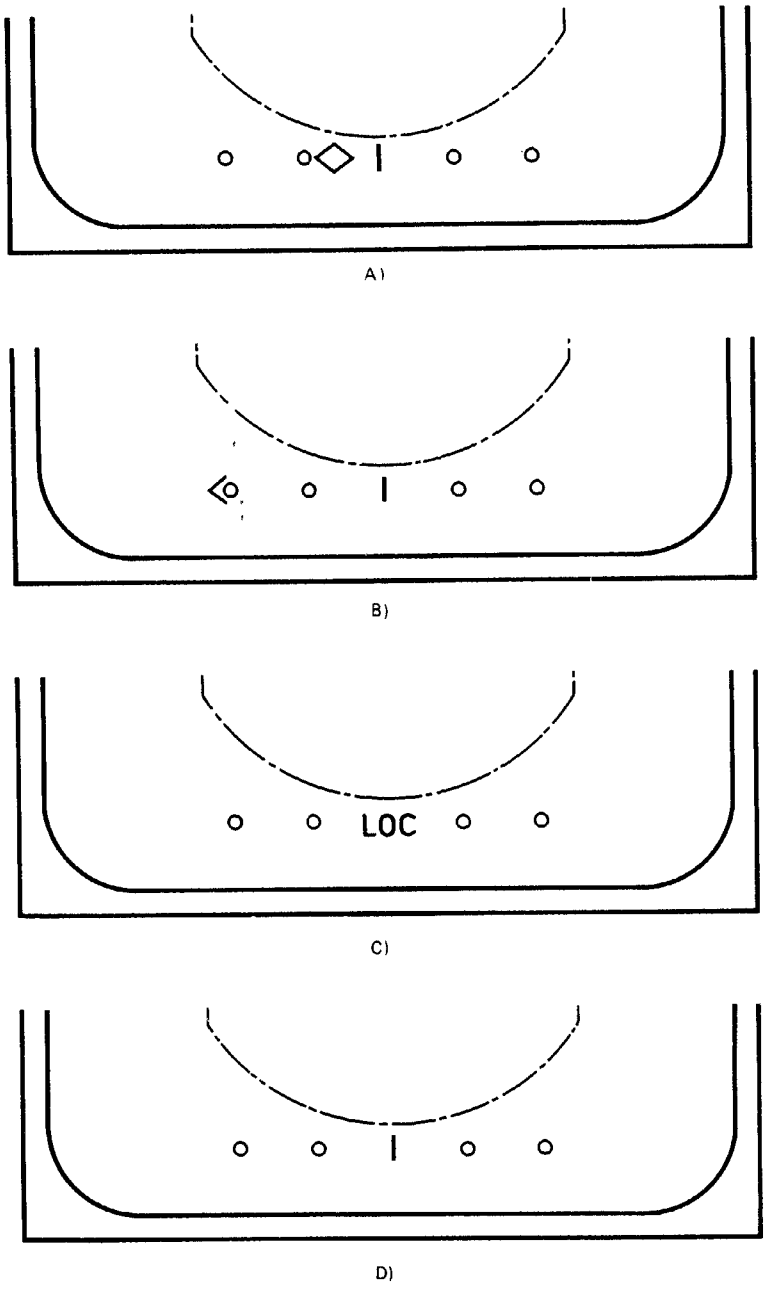
C) INDEX IN UPPER LIMIT

D) SELECTED ALTITUDE FAILURE OR BARO ALTITUDE FAILURE

1 BARO SET KNOB
PUSHED IN : BARO CORRECTED ALTITUDE
PULLED OUT : STANDARD FLIGHT LEVEL

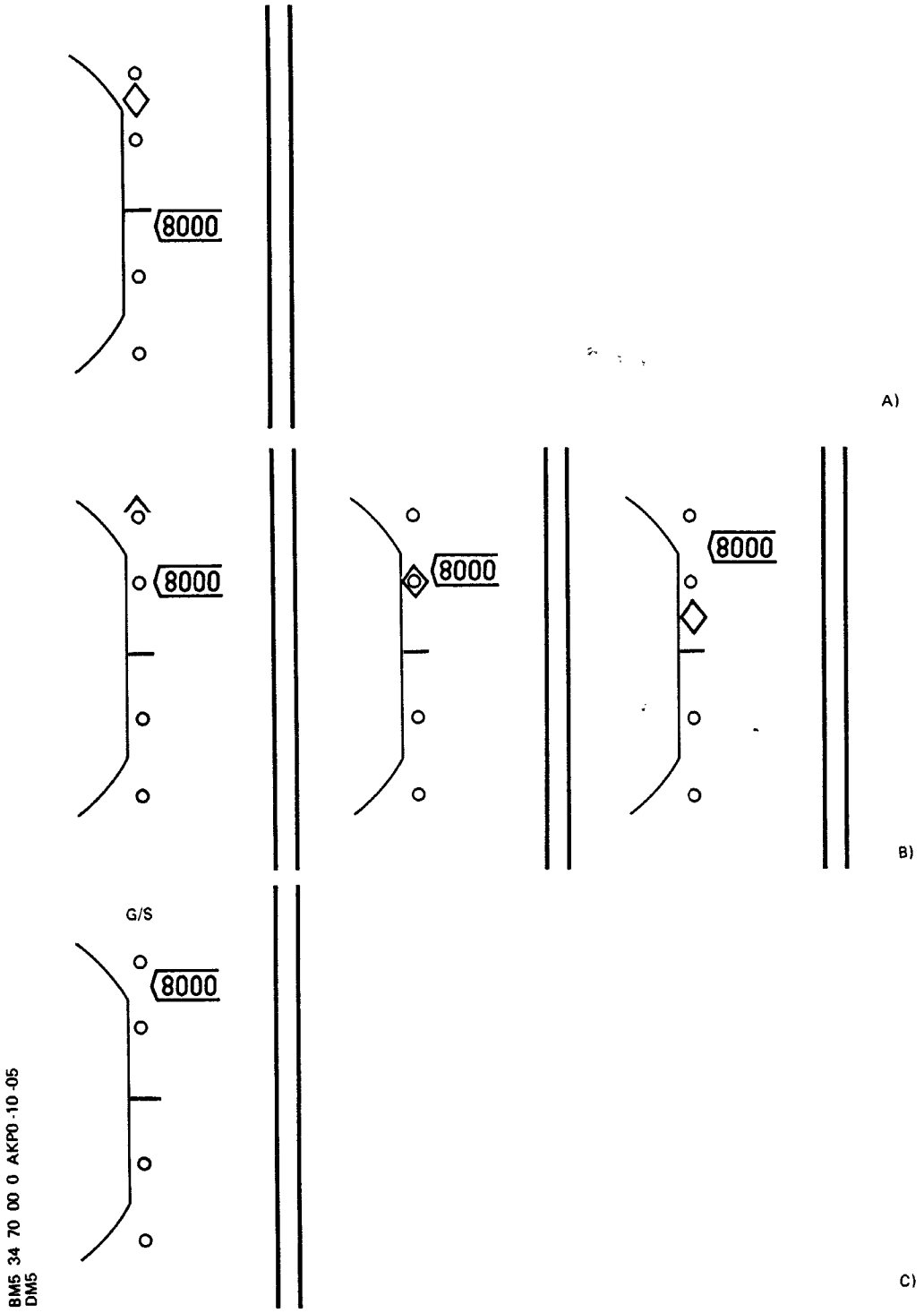
BM5 34 70 00 0 AHP0 09 04
DM5

PFD - Altitude Deviation Display
Figure 021

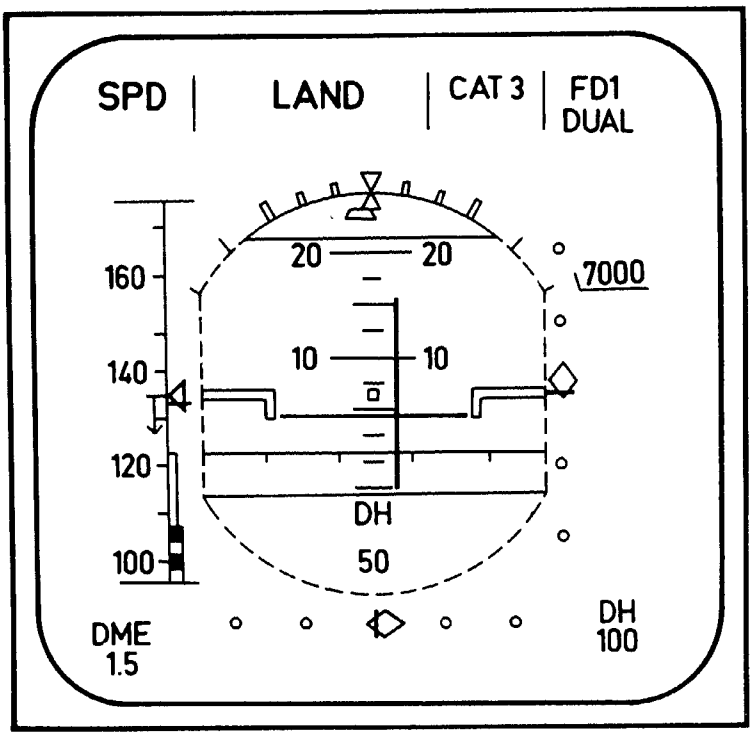


BM5 34 70 00 0 AJP0-09-04
DM5

PFD - LOC Deviation Display
Figure 022



PFD - Glide Slope Deviation
Figure 023



BM5 34 70 00 0 ALPU 09 04
DM5

PFD - ILS-DME Display
Figure 024

(4)Heading information
A blank heading scale graduated in 10° increments is provided on the horizon line.
The scale factor is 1.6 mm/degree (Ref. Fig. 025) (Part A).
This scale moves as the heading turns.
In the case of important nose-up attitudes, the horizon line disappears under the limit of the lower sector, but the heading graduations remain visible on this limit. (Ref. Fig. 025) (Part B)
In the case of important nose-down attitudes, the graduations remain visible on the limit of the upper sector (Ref. Fig. 025) (Part C)
On this heading scale move the selected heading and the flight path target symbols, in FPV mode (FPV/FD selector switch on complementary control panel in FPV position) (Ref. Fig. 026).
The selected heading symbolized by a cyan vertical dash represents the heading displayed on the FCU. The flight path target is only displayed in FPV mode when FPA key on EFIS control panel is pressed.
It represents the VOR selected course in VOR mode (or runway heading, in ILS mode) (Ref. para. B-6). It is not displayed in NAV mode.
In the case of heading failure, the scale and the symbols are cleared.

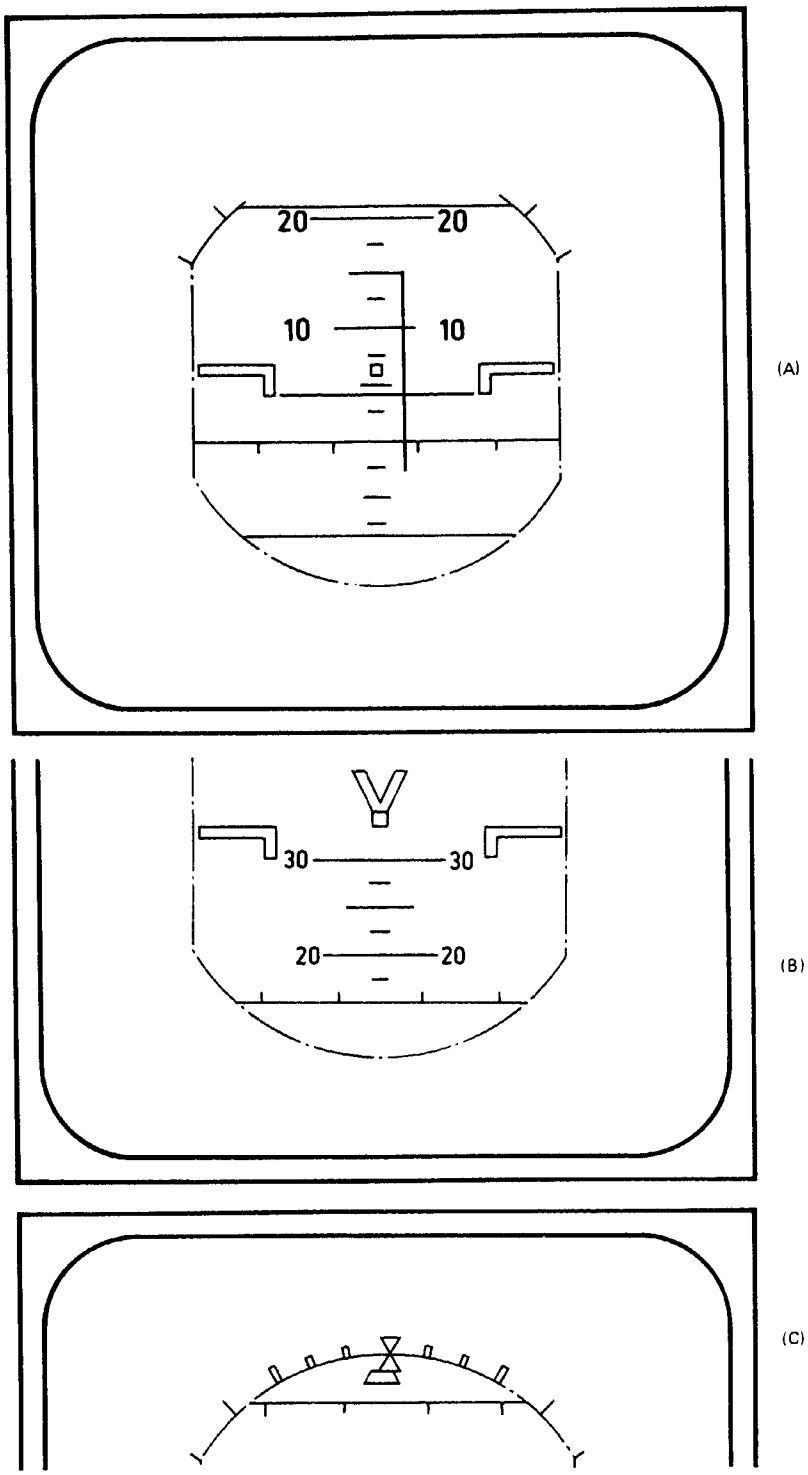
(5)Radio height

(a)Digital display
The ground height is displayed on the PFD for values below 2500 feet only, in the lower part of the sphere (sector 2) (Ref. Fig. 027) (Part B).
The dimension and color of the digits vary according to the height :
H greater than 1000 ft. : 4 mm green digits
H lower than 1000 ft. : 5 mm green digits
H lower than DH + 100 ft. : 5 mm amber digits
The variation step also depends on the altitude :
H greater than 50 ft. : 10 ft. steps
H between 5 and 50 ft. : 5 ft. steps
H lower than 5 ft. : 1 ft. step
In the event of failure of the radio altimeter in use, the system automatically switches over to the other one.
In the event of failure of both radio altimeters, the digits disappear and a red RA failure warning message, which first flashes for a few seconds is displayed instead (Ref. Fig. 027) (Part D).
This message appears only after slat extension.

(b)Analog display
At the end of the approach phase, an analog radio height indication is provided on the PFD : the white line which represents the limit of sector 2 moves up towards the horizon line, clearing the graduations on the pitch scale. The distance between the two lines is proportional to the ground height (5 ft./mm) (Ref. Fig. 027) (Part C).

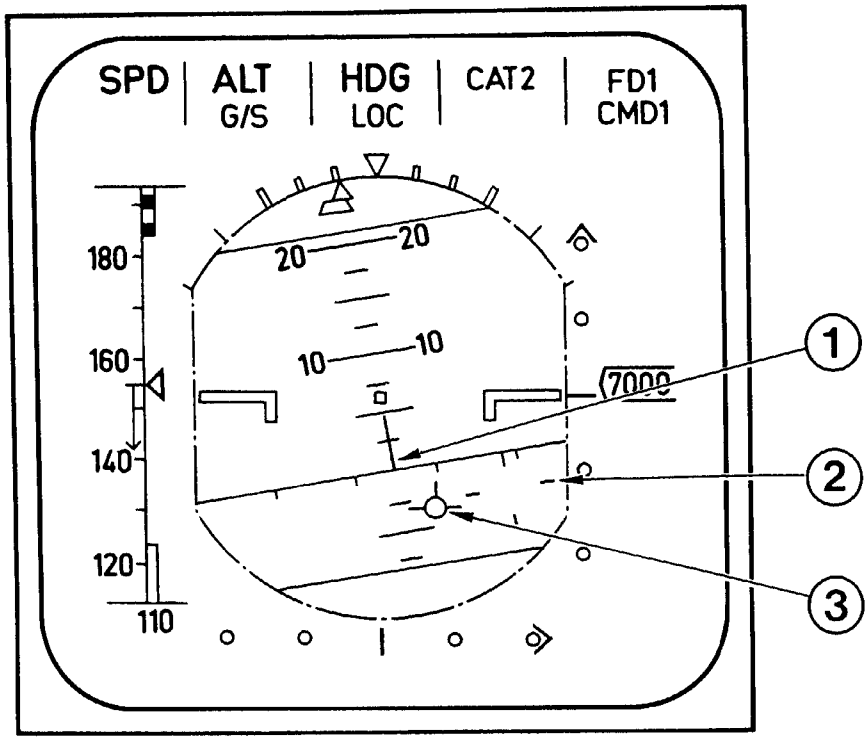
(c)Decision height (DH)
The decision height is displayed in cyan in the lower righthand corner of the PFD each time the radio height is below 2500 feet (Ref. Fig. 027).
In case of failure, the red DH failure warning message (without any digital value) is displayed.
In addition, when the radio height is lower than the decision height,

magenta DH digits are displayed in the sphere, and first flash for a few seconds.



BM5 34 70 00 0 AMP0 09-04
DM5

PFD - Heading Displays
Figure 025

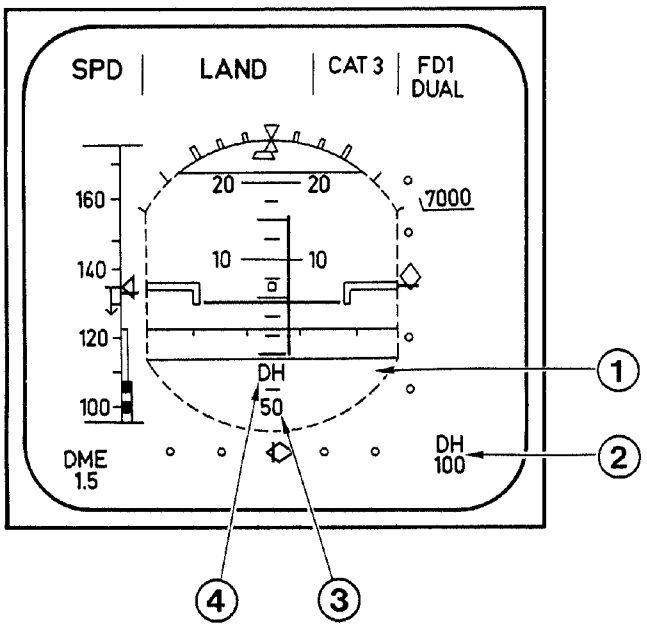


1 SELECTED HEADING
2 FLIGHT PATH TARGET
3 FLIGHT PATH VECTOR

BM5 34 70 00 0 ANPD 09 04
DM5

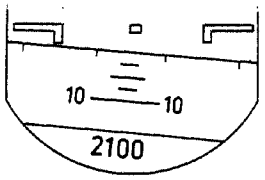
PFD - Symbols Displayed on Heading Scale
Figure 026

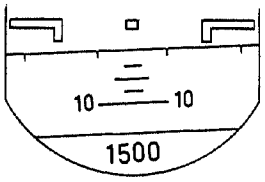
A



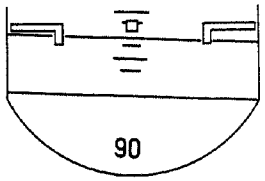
1 . ANALOG RADIO HEIGHT INDICATION
2 . DECISION HEIGHT
3 . DIGITAL RADIO HEIGHT
4 . WARNING H < DH

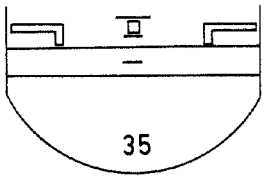
B



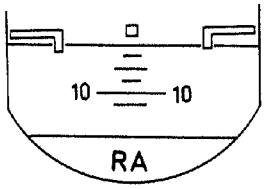


C





D



BM5 34 70 00 0 AQP0 00

PFD - Radio Height and Decision Height Display
Figure 027

(6)Steering orders

(a)Mode selection

The EFI system provides three modes of steering display :

- normal FD mode or FPV mode, selected through FPV/FD selector switch.
- OFF mode : FPV/FD selector switch also provides the possibility of cancelling the two previous modes of display.

When the switch is :

- in OFF lower position, no guidance symbol is displayed on the PFD
- in ON mid position, either the FD pitch and roll bars or the flight path symbols (flight path vector + flight path target + selected heading) are displayed.
- the upper position enables reversion to PFV mode, when in FD mode, and to FD mode, when in FPV mode. Then the selector switch returns to ON mid position.

NOTE : (1) On energization, or when FPV/FD selector switch is moved from OFF to ON position, the mode displayed is FD mode.

(2) When the selector switch is in ON position, engagement of certain AP modes causes automatic reversion to FD mode if the present mode is FPV.
The flight crew can come back to FPV mode by manually placing the switch in the upper position.

The AP modes concerned are : take-off (SRS RWY), roll out, go around, ALIGN.

(b)FD mode

The PFD displays the normal FD image of two crossed bars which move with respect to the aircraft symbol (Ref. Fig. 028) (Part A). These bars, green in color, have a travel range of ± 20 mm on either side of the centre point of the aircraft symbol :

- the horizontal bar commands vertical movement (nose-up or nose-down). Scale factor : ± 20 mm for ± 22.5°.

The bar flashes for 10 seconds if AP returns to basic mode on the longitudinal axis.

- the vertical bar commands horizontal movement (heading). Scale factor : ± 20 mm for ± 45°.

The bar flashes for 10 seconds if AP returns to basic mode on the lateral axis.

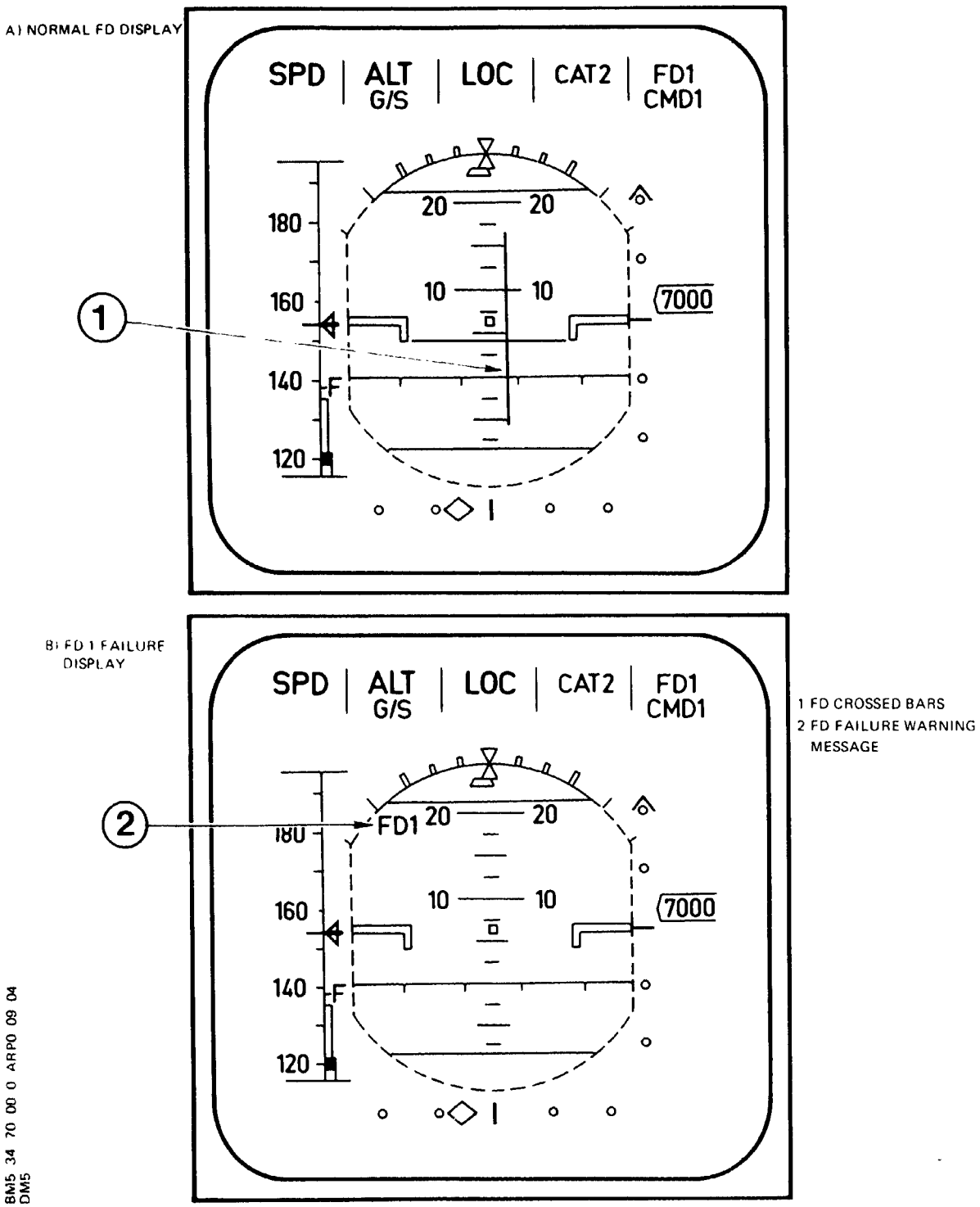
In ground configuration, the bar is replaced by a specific symbol which moves below the horizon line (Ref. Fig. 029). This symbol appears in ROLL OUT, SRS RWY and LAND modes, when H is lower than 30 ft. and pitch angle lower than 5°.

In case of FD failure, the bars and the roll out guidance symbol are cleared and a red FD1 (or FD2, depending on FD engaged) failure warning message, which first flashes for a few seconds, is displayed in the upper part of the sphere (Ref. Fig. 028) (Part B).

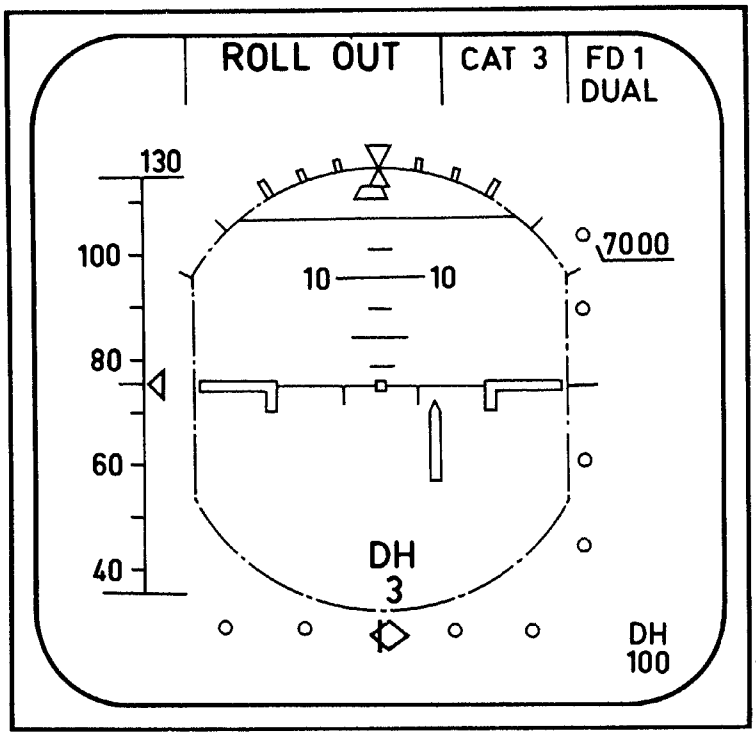
(c)FPV mode

The PFD presentation provides a new possibility for checking the aircraft trajectory, thanks to the symbols which are displayed in FPV mode :

- flight path vector (green)
- flight path target (cyan)
- selected heading (cyan)



PFD - FD Presentation
Figure 028



BM5 34 70 00 0 ASP0 00 04
DM5

PFD - Roll Out Guidance Display
Figure 029

1 The flight path vector provides display of the aircraft trajectory in path and slope
- the lateral deviation with respect to the aircraft symbol represents the drift.
- the vertical deviation with respect to the horizon line represents the slope followed
  . if the flight path vector is on the horizon line, the aircraft is in level flight
  . if it is below the horizon line, the aircraft is in descent configuration
  . if it is above the horizon line, the aircraft is in climbing configuration

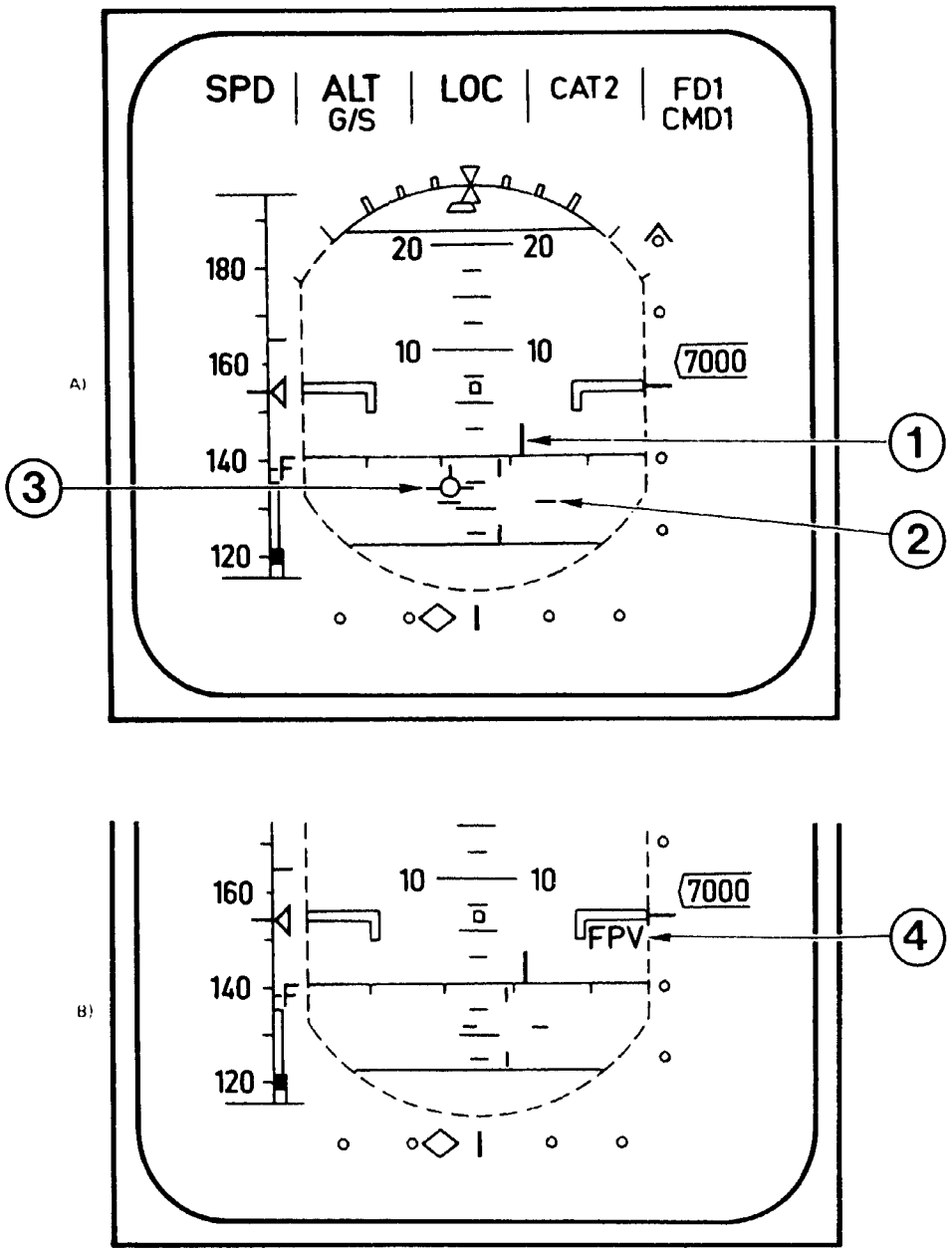
The pitch graduations serve as slope graduations (Ref. Fig. 030) (Part A).
The flight path vector is displayed in FPV mode whatever the AFS modes selected.
In case of failure, it is cleared and a red FPV failure warning message which first flashes for a few seconds, is displayed below the aircraft symbol (Ref. Fig. 030) (Part B).

2 The flight path target provides display of the trajectory selected in path and slope. It is only displayed when FPA key on EFIS control panel is pressed.
Its position with respect to the heading scale indicates :
- VOR selected course, when in VOR MODE
- the runway axis (QFU), when in ILS mode.

In NAV mode, the flight path target is not displayed.
The vertical deviation with respect to the horizon line represents the slope selected. This value is selected on EFIS control panel by pressing FPA pushbutton switch : it can vary from -9.9° to +9.9°.
The pitch graduations serve as slope graduations.
If the selected heading is out of display range on the heading scale, the target is against stop on the corresponding side, and only half of it is represented (Ref. Fig. 031)
In case of failure or loss of display (slope or course), the symbol is cleared.

3 Selected heading
The selected heading symbol is displayed on the heading scale in FPV mode. When the selected value is out of display range, the symbol remains against stop on the corresponding side (Ref. Fig. 031).

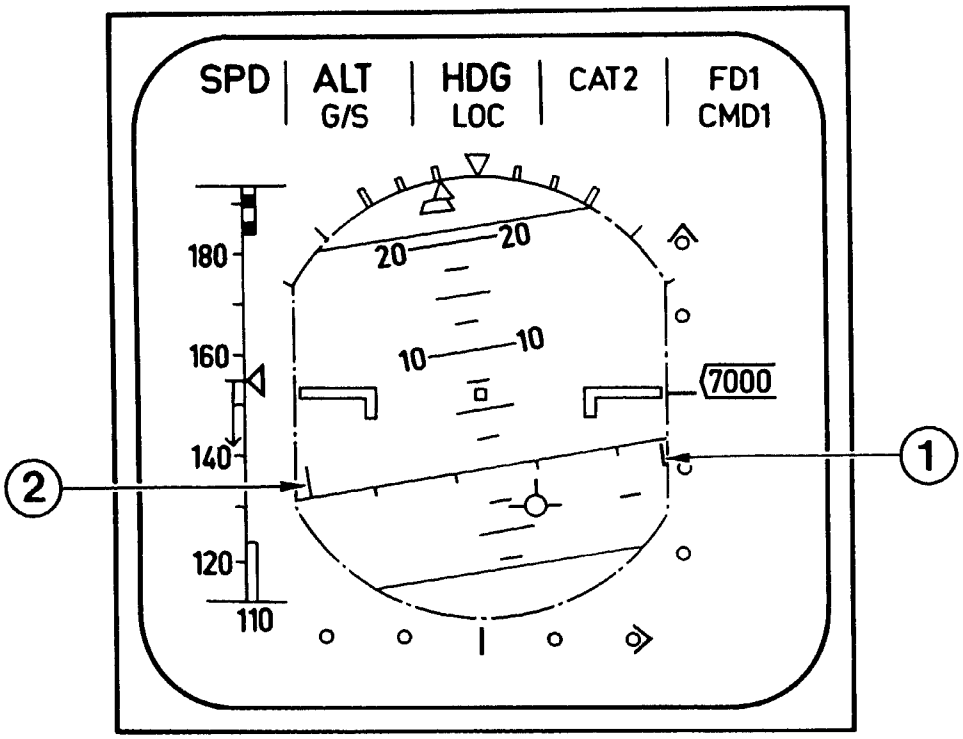
(7) Display of specific messages
In certain flight conditions, specific messages are displayed on the PFD, to ask the crew to take specific actions.
These messages are displayed in amber below the capability and engagement indications, and flash to attract crew's attention.
These are :
- MORE DRAG : message displayed above the vertical deviation scale when drag has to be increased
- DECELERATE : message displayed above the vertical deviation scale when thrust has to be reduced.
- WINDSHEAR : in the event of windshear detection, message is displayed in the sky zone and has priority over ROLL OUT.



1 SELECTED HEADING
2 FLIGHT PATH TARGET
3 FLIGHT PATH VECTOR
4 FPV FAILURE WARNING MESSAGE

BM.5 34 70 00 0 ATP0 09 04
DM.5

PFD - Flight Path Vector Presentation
Figure 030



1 FLIGHT PATH TARGET
2 SELECTED HEADING

BM5 34 70 00 0 AUP0 09 04
DM5

PFD - Flight Path Target and Selected Heading Out of Display Range
Figure 031

- ROLL OUT : roll out phase (LAND mode).

(Ref. Fig. 032)

(8)Mode annunciators

The upper part of the PFD is used for display of AFS modes

(Ref. Fig. 033)

These are as follows :

- autothrottle mode
- AFS longitudinal modes
- AFS lateral modes
- landing capability availability
- system engagements

The engaged modes are displayed in green on the first line (4 mm).

The armed modes are displayed in cyan on the second (or third) line (3 mm).

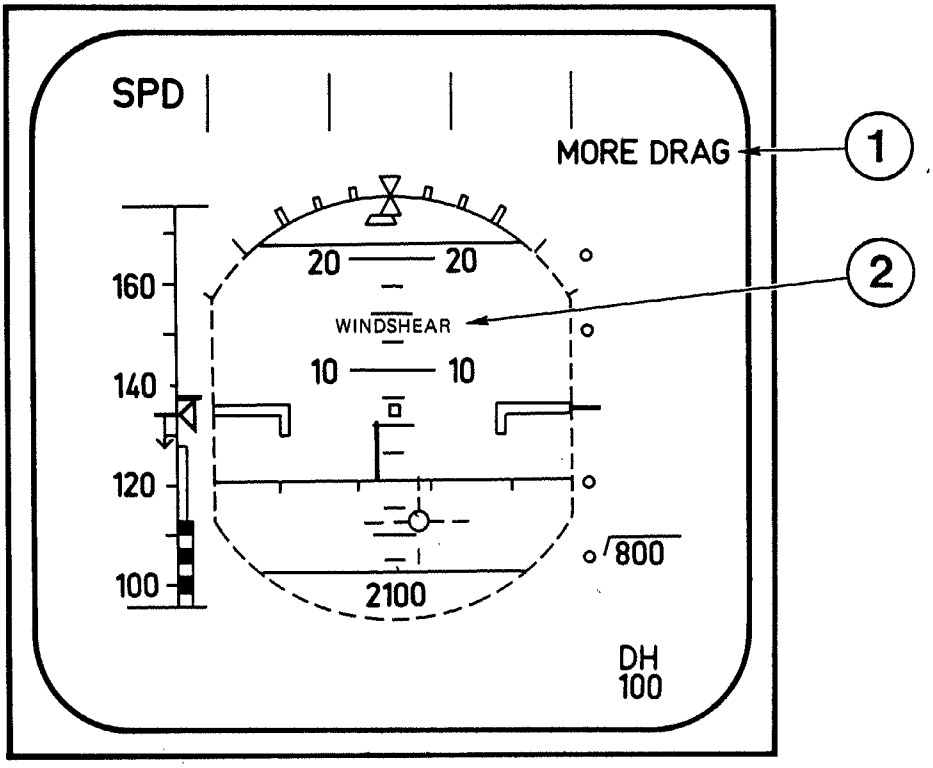
The capability indication is displayed in magenta.

The engagements are displayed in white or amber :

- FD engagements on the first line
- AP engagements on the second line : CMD, DUAL (white), CWS (amber).

The modes that can be displayed are listed in the following tables.

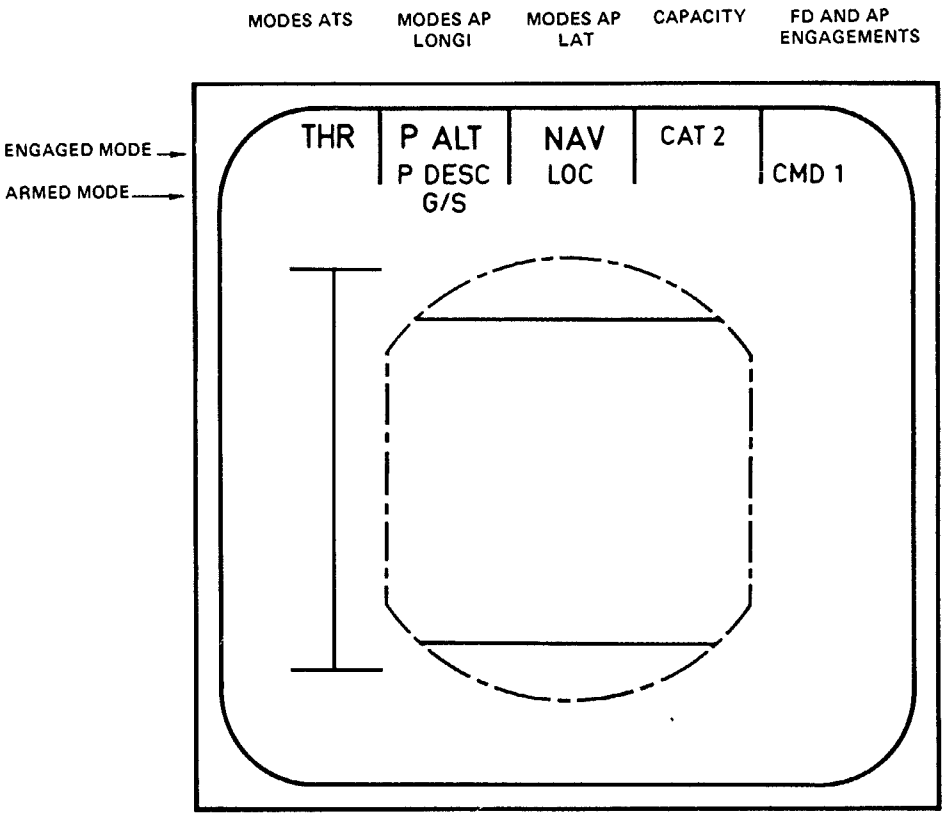
**ON A/C ALL



1 - MORE DRAG OR DECELERATE
2 - WINDSHEAR OR ROLL OUT

BM5 34 70 00 0 AVS0 24 04
DM5

PFD - Specific Message Display
Figure 032



BM5 34 70 00 0 AWP0 13 09
DM5

PFD - Flight Mode Annunciator Layout
Figure 033

R TABLE 1
R ATS MODES (ARMED AND ACTIVE) DISPLAY

DISPLAY	COLOR	SIGNIFICATION
SPD	GREEN	Speed Selection Mode
MACH	GREEN	Mach Selection Mode
THR	GREEN	EPR Mode Engaged
THR	GREEN	N1 Mode Engaged
RETARD	GREEN	Throttle retarded
THR	CYAN	Autothrottle declutched after take-off
THR	CYAN	Autothrottle declutched after take-off
P THR	GREEN	N1 mode engaged through FMC (Atlas Version)
P THR	GREEN	EPR mode engaged through FMC (KSSU Version)
P SPD	GREEN	Speed mode engaged through FMC (provision)
P MACH	GREEN	Mach mode engaged through FMC
MAN THR	AMBER	Autothrottle decluctched
(pulsing)		
A/THR	CYAN	A/THR mode armed
THR.L	GREEN	N1 LATCH mode engaged
(flashing)		(alpha floor condition absent)
THR.L	GREEN	EPR LATCH mode engaged
(flashing)		(alpha floor condition absent)
THR.L	GREEN	N1 LATCH mode engaged by alpha floor
(steady)		
THR.L	GREEN	EPR LATCH mode engaged by alpha floor
(steady)		
DFA	GREEN	DFA mode engaged (if fitted)
DFA	CYAN	DFA mode armed (if fitted)

**ON A/C ALL

TABLE 2
AP/FD LONGITUDINAL ACTIVE MODES (GREEN)

DISPLAY	COLOR	SIGNIFICATION
ALT*	GREEN	Altitude acquire mode active
ALT	GREEN	Altitude mode active
SPD	GREEN	Speed hold mode active
MACH	GREEN	Mach hold mode active
P ALT	GREEN	PROFILE mode (level flight) active (Coupling to FMC)
P CLB	GREEN	PROFILE mode (climb) active (coupling to FMC)
P DESC	GREEN	PROFILE mode (descent) active (coupling to FMC)
GS*	GREEN	Glide capture
GS	GREEN	Glide hold
SRS	GREEN	Longitudinal guidance after selection of a lateral mode (GA mode)
		Longitudinal guidance in TAKE-OFF mode
V/S	GREEN	Vertical Speed hold mode active

* Flashing for a few seconds, then steady.

TABLE 3
AP/FD LATERAL ACTIVE MODES (GREEN)

DISPLAY	COLOR	SIGNIFICATION
HDG	GREEN	Heading hold
HDG/S	GREEN	Selected heading hold
NAV*	GREEN	Lateral track capture (NAV mode)
NAV	GREEN	Lateral track hold (NAV mode)
VOR*	GREEN	VOR capture
VOR	GREEN	VOR hold
LOC*	GREEN	LOC beam capture
LOC	GREEN	LOC beam hold
HDG	GREEN	Lateral guidence after selection of a longitudinal mode (GA mode)
RWY	GREEN	Lateral guidance in TAKE-OFF mode

* Flashing for a few seconds, then steady

TABLE 4
AP/FD ARMED LONGITUDINAL MODES (CYAN)

DISPLAY	COLOR	SIGNIFICATION
P DESC*	CYAN	PROFILE mode armed for descent
P CLB*	CYAN	PROFILE mode armed for climb
G/S	CYAN	GLIDE mode armed (LAND mode)
ALT	CYAN	ALT ACQ mode armed

* NOTE : These indications can be displayed with P.ALT (green) indication
P DESC-GS and P CLB-GS and ALT-GS combinations are possible.

TABLE 5
AP/FD ARMED LATERAL MODES (CYAN)

DISPLAY	COLOR	SIGNIFICATION
LOC	CYAN	LOC mode armed (LOC or LAND mode)
NAV	CYAN	NAV mode armed
VOR	CYAN	VOR mode armed
HDG/S	CYAN	HDG/SEL Mode armed at take-off (TAKE-OFF mode) This indication will be displayed at the same time as SRS-RWY indication

TABLE 6
AP/FD COMMON MODES (Indications displayed across dividing line)

DISPLAY	COLOR	SIGNIFICATION
FLARE	GREEN	LAND mode flare phase
GO AROUND	GREEN	GO AROUND mode engaged on both axes
LAND	GREEN	GS track and LOC track phases active, and H < 400 ft.
ROLL OUT	GREEN	ROLL OUT phase (LAND mode)

TABLE 7
CAPABILITY DISPLAY

DISPLAY	COLOR	SIGNIFICATION
CAT 1	MAGENTA	LAND mode engaged (armed or active), only Category I is available
CAT 2	MAGENTA	LAND mode engaged (armed or active) Category II available
CAT 3	MAGENTA	Both AP engaged, LAND mode engaged. Category III available "Fail operational"
CAT 3	WHITE	One AP available, LAND mode engaged, Category III "fail passive" available

TABLE 8
AP/FD ENGAGEMENTS

DISPLAY	COLOR	SIGNIFICATION
FD X	WHITE	Flight director engaged (The FD which commands the bars shall be mentioned on each PFD : FD X)
CWS	WHITE	AP engaged in CWS (CWS1 or CWS2 mentioned, depending on CWS engaged, as per Par. 13.2
CMD	WHITE	AP engaged in CMD (Engaged side (CMD1 or CMD2) shall be mentioned, as per par. 13.2)
DUAL	WHITE	Both APs engaged (LAND or GA mode), as per par. 13.2

NOTE : CWS1 or 2, CMD1 or 2 and DUAL information can be associated with FD1 or FD2 indications showing on corresponding PFD which FD commands the bars

TABLE 9
LOSS OF DECRAB/ROLL OUT FUNCTION

DISPLAY	COLOR	SIGNIFICATION
ROLL OUT	AMBER	Loss of decrab/roll out function (LAND mode)

ROLL OUT indication will be displayed in the sky zone.

C. Operation on ND

The navigation data provided by the ND can be displayed in various forms, depending on the mode selected on the control panel.
The modes which are available are :

- rose mode : display is similar to that of a conventional HSI. It utilizes mainly IRS and radio navigation aid data.
- arc mode : the ND only displays part of the heading scale around the aircraft heading. All the symbols displayed in Rose mode are also displayed (except ADF symbols).
  The radar image can also be displayed.
- map mode : in this mode, it is a dynamic display which gives the position of the aircraft with respect to the flight plan. It utilizes mainly FMC data. The radar image can also be displayed
- plan mode : this mode enables display of the flight plan in the form of a static map.

NOTE : In case of EFIS control panel failure, the ND is automatically switched to Map mode, with a range of 30 NM.

(1)ROSE mode

(a)Heading and course information (Ref. Fig. 034)

1 Aircraft heading

It is given by a turning scale graduated in five degree increments and orientated to the magnetic heading which is represented by a yellow triangular index.
In case of heading failure, the scale and the symbols that can no longer be positioned such as selected heading, selected course etc, are cleared.
A red HDG failure warning message which first flashes during a few seconds, is displayed above the rose (Ref. Fig. 035) (Part A).
This flag can be displayed :

- in the event of failure of the source utilized
- when the EFIS internal monitoring has detected a heading anomaly.

When a discrepancy is detected between sides 1 and 2 by the external monitoring, that is by the FWC, an amber CHECK HDG failure warning message is displayed on each ND. However, the heading remains displayed (Ref. Fig. 035). (Part B).
The flight crew performs cross checks using the standby compass for example.

2 Selected heading

The selected heading is represented by a cyan line which moves along heading scale (Ref. Fig. 034) (Part A).
In case of failure, this symbol is cleared (Ref. Fig. 034) (Part B).

3 Selected course

It is represented by a cyan pointer (Ref. Fig. 034) (Part A).
The pointer turns inside the rose according to the selected course value

- either VOR radial, when in VOR mode (VOR/NAV/ILS selector switch in VOR position)
- or runway axis, when in ILS mode (VOR/NAV/ILS selector switch in ILS position).

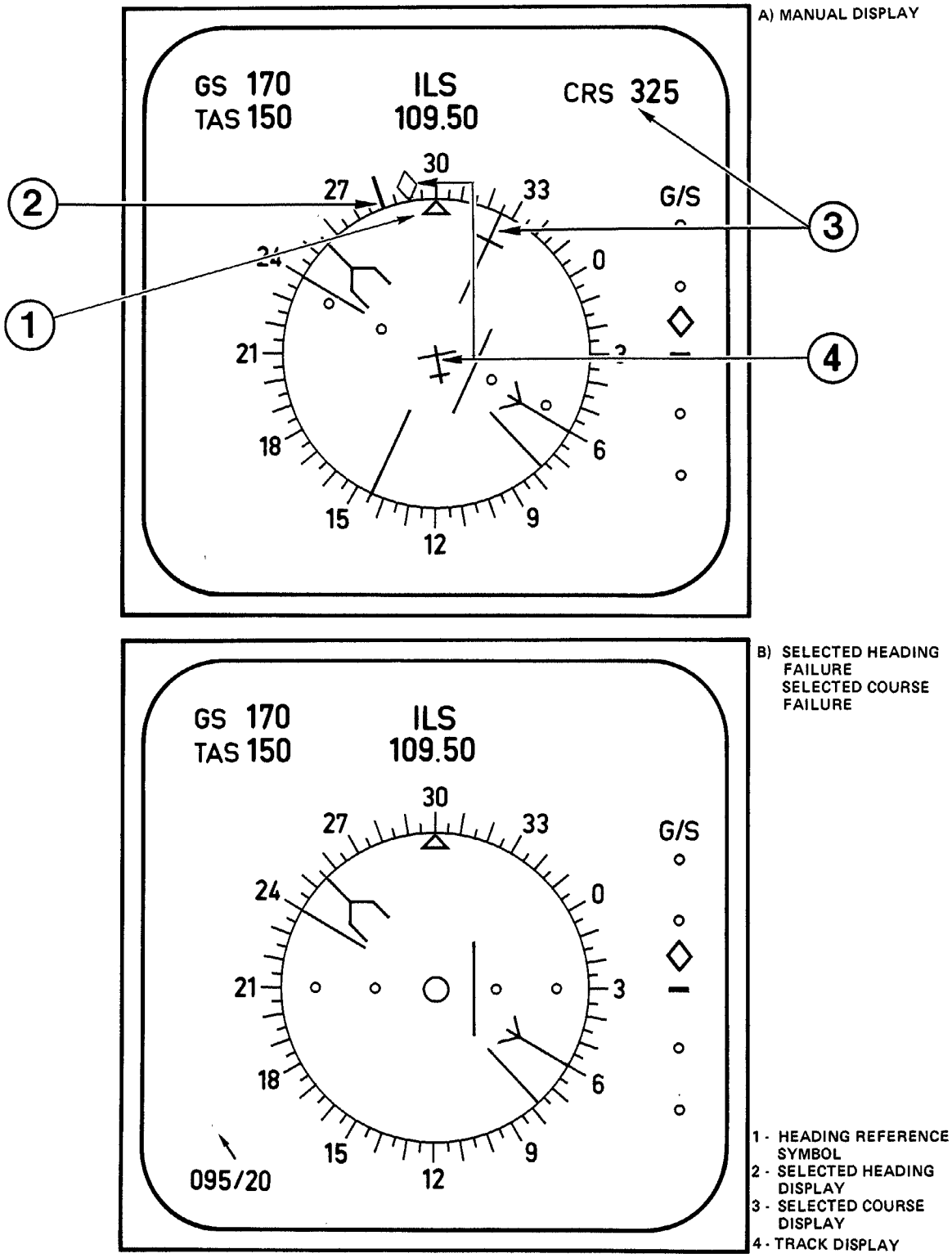
The pointer is not displayed in NAV mode.

The digital value is clearly spelt out in cyan in the upper righthand corner.
The center part of the pointer serves as lateral deviation index.
In case of failure, the pointer is cleared (Ref. Fig. 034) (Part B).

4 Track
The track is represented by a green diamond shape. It is also indicated by the direction of the aircraft symbol in relation to the lubber line (Ref. Fig. 034) (Part A).
In the event of track data failure the aircraft symbol is replaced by a yellow circle and the track index is cleared (Ref. Fig. 034) (Part B).

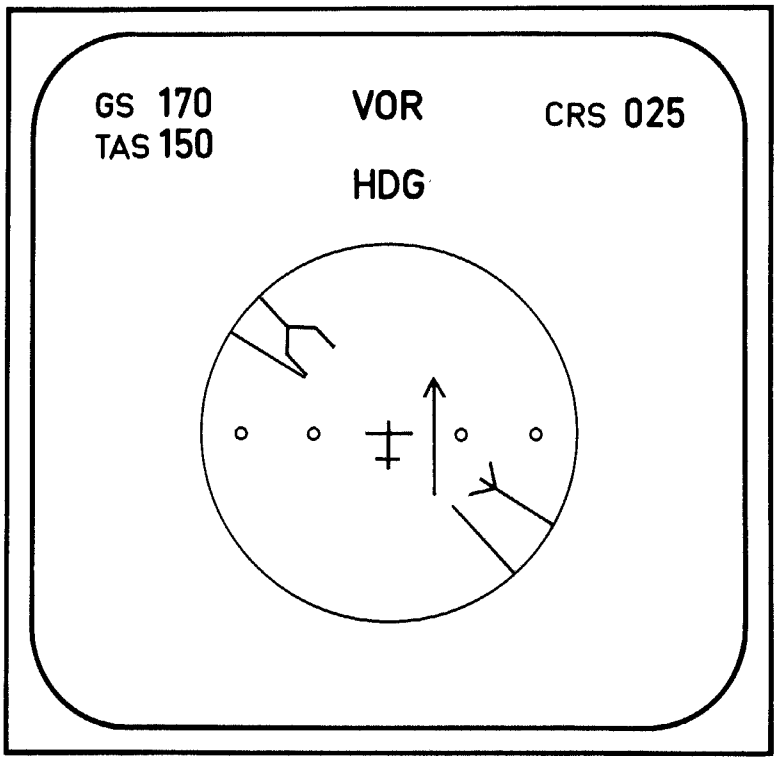
(b) ADF bearings
Two bearings are available simultaneously. Dual ADF pointers and tails (with opposite bearings) are displayed on the rose (Ref. Fig. 036) (Part A) :
- Pointer 1 (ADF1) : magenta
- Pointer 2 (ADF2) : green

In the event of ADF1 or 2 failure, the corresponding pointer and tail are cleared :
ex : ADF2 failure (Ref. Fig. 036) (Part B).
Also, in the event of non-reception (out of range), pointer and tail are cleared.
(Ref. Fig. 036)

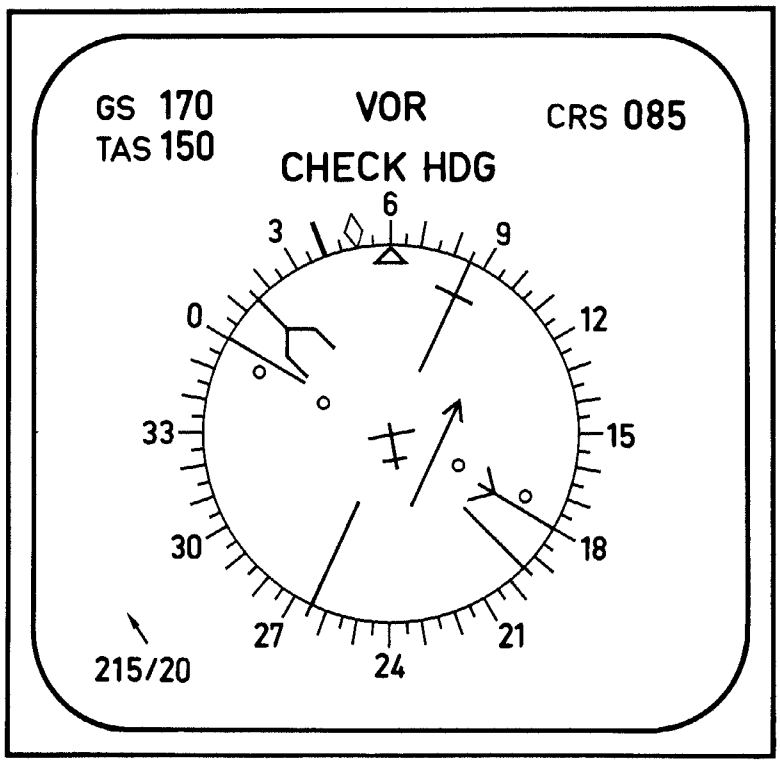


BM5 34 70 00 0 CAB0 28 23
DM5

ND - ROSE Mode - Heading and Course Display
Figure 034



A) HEADING FAILURE

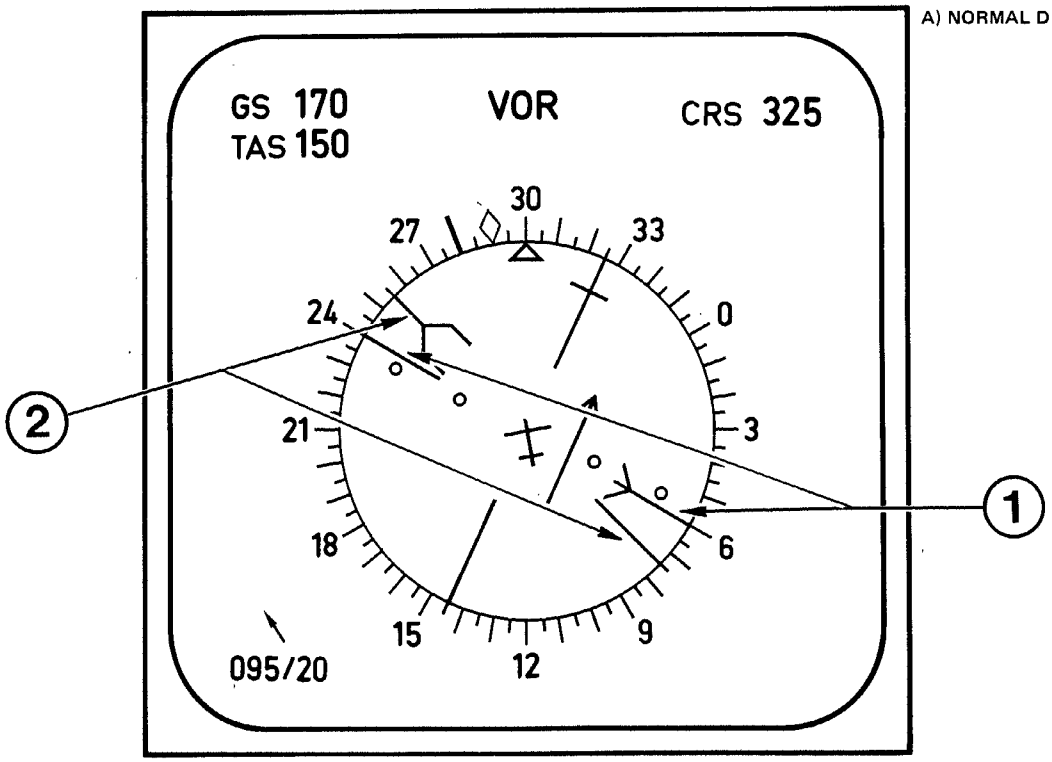


B) HEADING DISCREPANCY

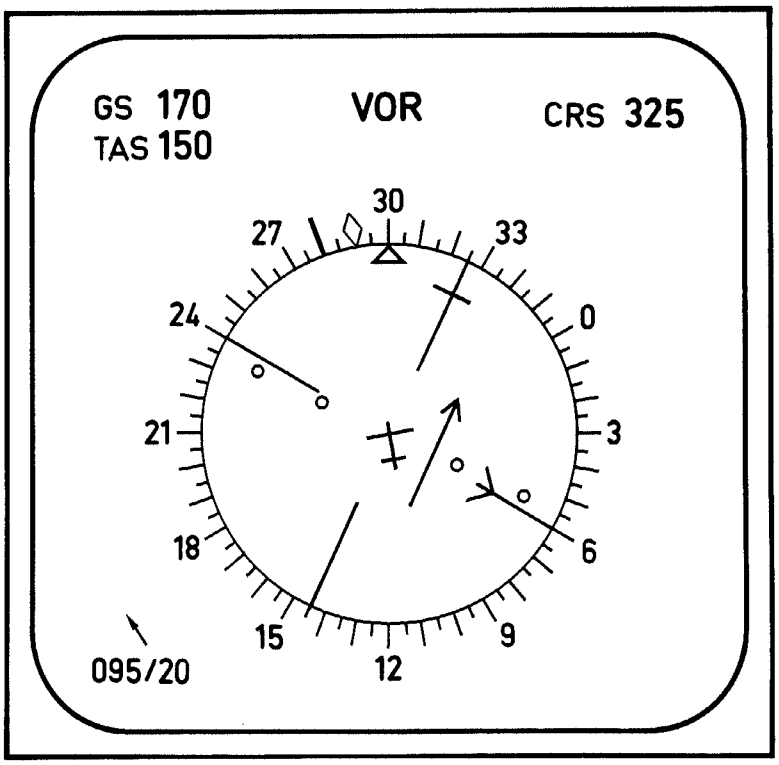
BM5 34 70 00 0 AYW0 28 23
DM5

ND - ROSE Mode - Heading Warning Messages
Figure 035

A) NORMAL DISPLAY



B) ADF 2 FAILURE



1 - ADF 1 POINTER
2 - ADF 2 POINTER

BM5 34 70 00 0 AZW0 28 23
DM5

ND - Rose Mode - ADF Display
Figure 036

(c)Trajectory deviations

The deviations which are displayed depend on the position of VOR/NAV/ILS mode selector switch located on the EFIS complementary control panel.

1 VOR mode

Only the white lateral deviation scale is displayed in the rose. It is perpendicular to the selected course pointer and turns with it.
The position of the center part of this pointer on the scale gives the angular deviation with respect to the selected course.
The scale factor is 5 degrees per dot.
The maximum travel range is 10 degrees. Beyond this value, the bar is against stop.
In the case of no computed data, (VOR not received, for example), the bar is cleared.
In the case of failure, the bar is cleared and a red VOR failure warning message which first flashes for a few seconds, is displayed in the center of the rose.
(The scale remains horizontal if the selected course value is not available).

2 NAV mode

No deviation is displayed in this mode. The scale is not represented.

3 ILS mode

- Lateral deviation

The deviation scale presents a LOC deviation.
In this case, the deviation bar is magenta.
The sensitivity is 0.155 ddm (150 μA) for two dots.
Beyond the second dot, the bar is against stop.
In case of excessive deviation warning, the bar and the scale flash.
In case of no computed data, the bar is cleared.
In case of failure, the bar is cleared and a red LOC failure warning message is displayed in the center of the rose.

- Vertical deviation

The vertical deviation scale, which is white, is displayed in ILS mode or in any case of non-precision approach. It gives a normal glide slope deviation.
The sensitivity is 0.175 ddm (150 μA) for two dots.
Beyond the second dot, the glide slope index is against stop.
In case of excessive deviation warning, the index and the scale flash.
In case of no computed data, the index is cleared.
In case of failure, the index is cleared and a red G/S failure warning message, which first flashes for a few seconds, is displayed in the center of the scale.

(d)Digital data

1 Ground speed and true airspeed

The ground speed and true airspeed are displayed in green in the upper lefthand corner of the ND.
If this data is not available, the digital values are replaced by dashed lines : ex : GS - - -.
In the case of failure, the data is cleared.

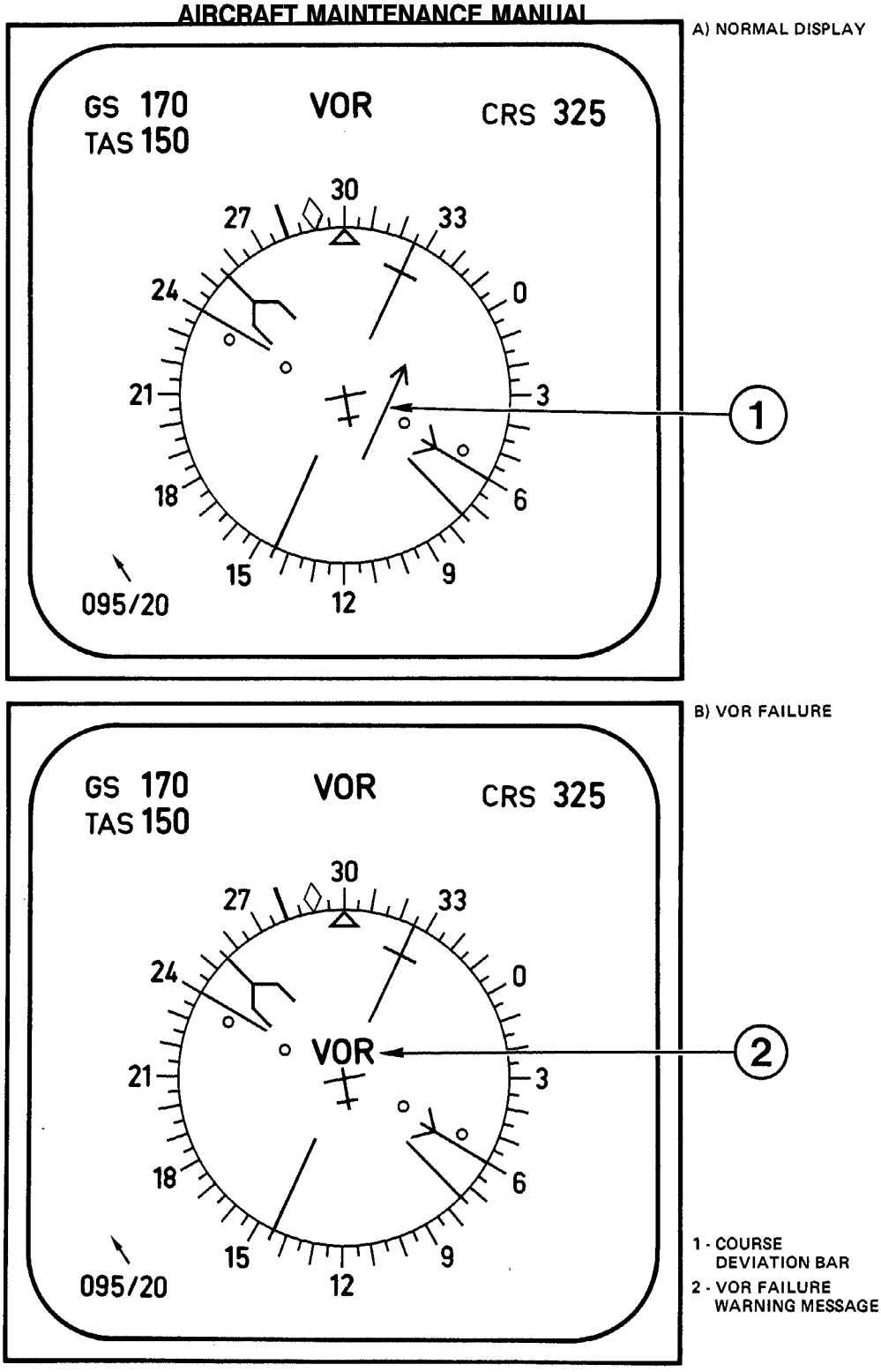
2 Selected course

The selected course digital value is displayed in cyan in the upper righthand corner of the **ND**.
In case of no computed data, it is replaced by dashed lines.
In case of failure, it is cleared.

3 Wind data
The wind direction and speed are displayed in green in the lower lefthand corner of the **ND**.
The pointer indicates the wind direction.
The digits indicate the direction where the wind comes from and its speed.
In case of failure, the data is cleared.

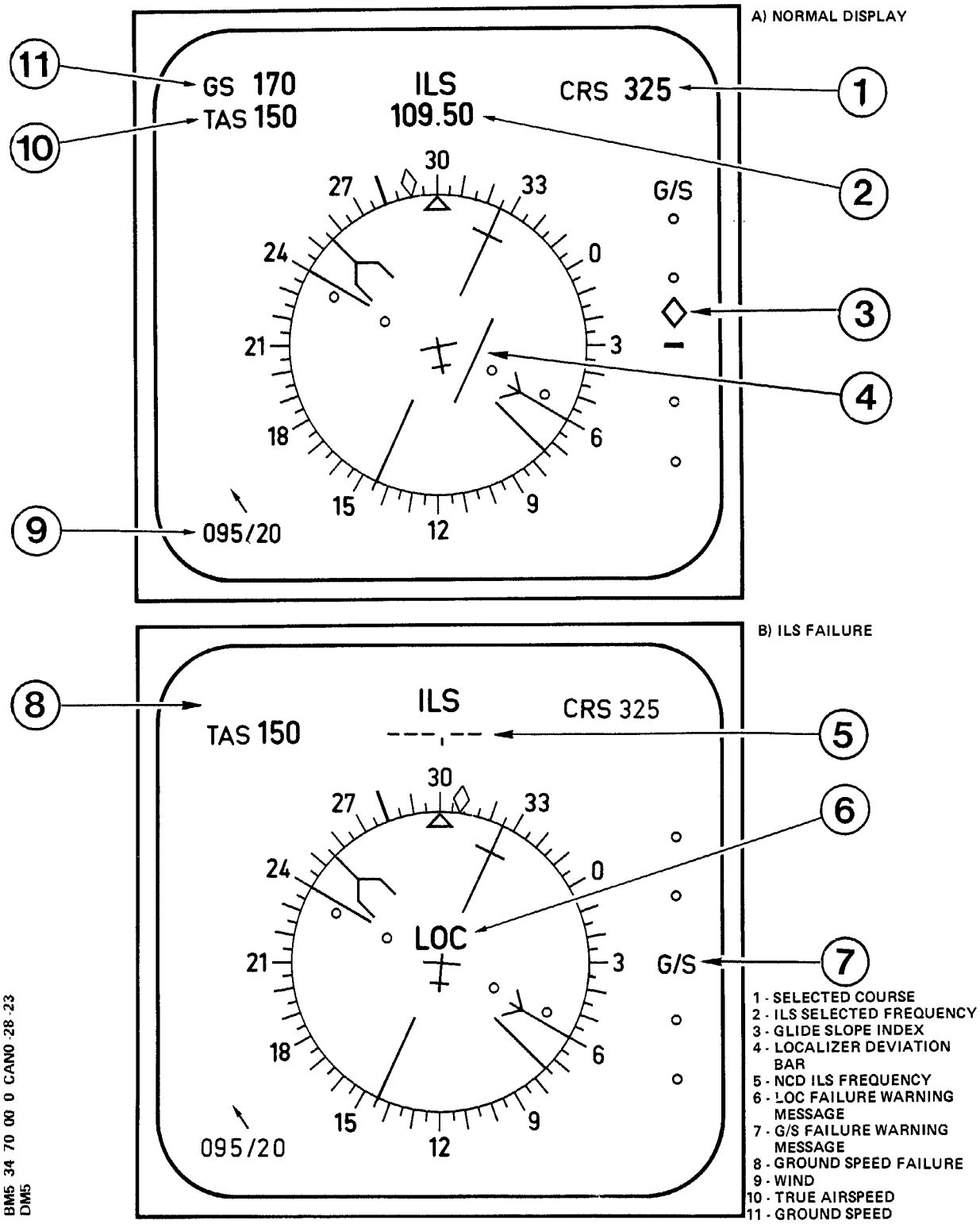
4 Selected frequency (in **ILS** mode only)
The frequency selected on **ILS** control box is displayed in cyan below the **ILS** message.
In case of no computed data, it is replaced by dashed lines.
In case of failure, it is cleared.

(Ref. Fig. 037)
(Ref. Fig. 038)



BM5 34 70 00 0 ABW0 28 23
DM5

ND - ROSE Mode - VOR Display
Figure 037



BM5 34 70 00 0 CAN0 28 23
DM5

ND - ROSE Mode - ILS Display
Figure 038

(2)ARC mode

This mode is available when the mode selector switch located on the control panel is in ARC position.

The ND display then resembles that of Rose mode.

(a)Heading and course data

A heading scale is displayed in white in the upper part of the map. It moves in relation to the aircraft heading.

1 Aircraft heading (magnetic heading)

The aircraft heading is represented by a yellow triangular index in the center of the scale.

In case of heading failure, the graduations are cleared, together with the symbols that can no longer be positioned.

A red HDG failure warning message, which first flashes during a few seconds, is displayed above the heading scale (Ref. Fig. 040) (Part A).

This flag is displayed :

- in the event of failure of the source utilized
- when the EFIS internal monitoring has detected a heading anomaly.

When a discrepancy between sides 1 and 2 has been detected by the external monitoring, therefore by the FWC, an amber CHECK HDG warning message is displayed on both NDs.

However, the heading remains displayed (Ref. Fig. 040) (Part B).

The flight crew performs cross checks using the standby compass, for example

2 Selected heading

The selected heading is represented by a cyan line which moves along the heading scale.

When the heading value is out of display range, it is clearly spelt out on the side where the line is against stop.

In case of failure, the index is cleared.

3 Track (Ref. Fig. 039)

The track is represented by a green diamond shape and also by the direction of the aircraft symbol in relation to the lubber line.

In the event of track data failure, the aircraft symbol is replaced by a yellow circle and the track index is cleared.

(b)Course deviation - Interception of the flight level selected

1 Lateral deviation

In ARC mode, the ND displays the course deviation in relation to the selected course.

The scale indicates :

- either the deviation in relation to the radial selected (in VOR mode)
- or LOC deviation (in ILS mode).

In NAV mode, no deviation is indicated.

In the event of VOR (or LOC) data failure, the lateral deviation bar is cleared and red VOR (or LOC) failure warning message is displayed in the center of the scale.

2 Vertical deviation

The vertical deviation scale is only displayed in ILS mode or in any case of non-precision approach. It indicates a normal glide slope deviation.

In the event of failure, the glide slope index is cleared, and red G/S warning message is displayed in the center of the scale.

3 Interception of the flight level selected
The presumed altitude intercept point is indicated by a yellow arc of a circle.

(c)Digital data

1 Groundspeed and true airspeed data
These are displayed in green in the upper lefthand corner of the ND.
They are cleared in the event of failure.

2 Selected course data
In addition to pointer display, the digital value is displayed in cyan in the upper righthand corner of the ND. It is cleared in the event of failure.

3 Wind data
Wind speed and direction are displayed in green in the lower lefthand corner of the ND.
The direction is also indicated by an arrow.
Wind data is cleared in the event of failure.

4 Selected frequency (in ILS mode only)
The frequency selected on ILS control box is displayed in cyan below the ILS message.
In case of no computed data, it is replaced by dashed lines.
In case of failure, it is cleared.

(d)Radar image

The radar image is displayed on the ND when the transceiver is switched on on radar control unit.

1 Echo processing
The echoes can be displayed in three different colors (green, amber, red) depending on their intensity. The weakest are green, the strongest are red.
The image display is as a function of the range selected on EFIS control panel.
Antenna tilt setting is indicated in cyan in the lower righthand corner of the ND.
It is cleared in case of radar failure.

2 Radar failure display
Radar transceiver anomalies are displayed in the lower righthand corner of the ND (Ref. Fig. 040) (Part C).
They are listed in descending order of importance. Only the most important one shall be displayed.
Failures resulting in an interruption of image display.
- Transmitter failure : the message displayed is WR T-R (red)
- Antenna failure : the message is WR ANT (red)
- Control failure : the message is WR CTL (red)
- Range failure (Disagreement with the value displayed on the control unit) : the message is WR RNG (red)

Failures that do not result in an interruption of image display.

- Calibration : the message displayed is **WR WEAK** (amber)
- Attitude : the message displayed is **WR ATT** (amber)
- Stabilization : the message displayed is **WR STAB** (amber)

3 **TEST** mode

When the radar is in **TEST** mode, a specific image is displayed. The corresponding message is **WR TEST** (amber)

The radar image is not displayed if a radar failure is reported.

4 Change of range

After a change of range, the image is not displayed instantaneously. During this time lag, **RANGE CHANGE** message is displayed.

R ****ON A/C** 101-200,

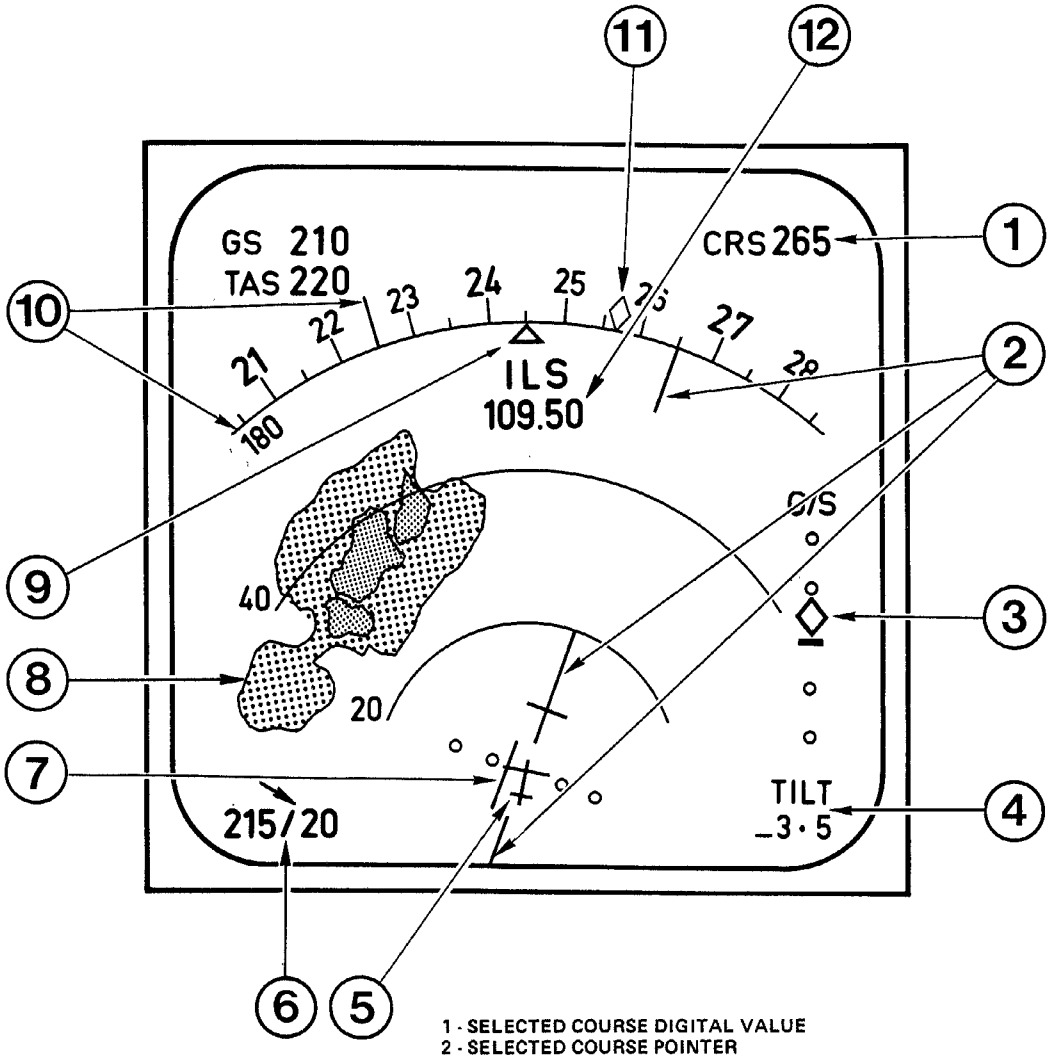
R (e)**TERRAIN** image thru **EGPWS**

R The terrain image is displayed on the **ND** when **TERR MODE** pushbutton switch is selected **ON** on panel 402VU.

R The background terrain is depicted as variable density dot patterns in green, yellow and red. The density and color being a function of how close the terrain is relative to aircraft altitude. Terrain alerts are depicted by painting the threatening terrain as solid yellow or red.

R ****ON A/C ALL**

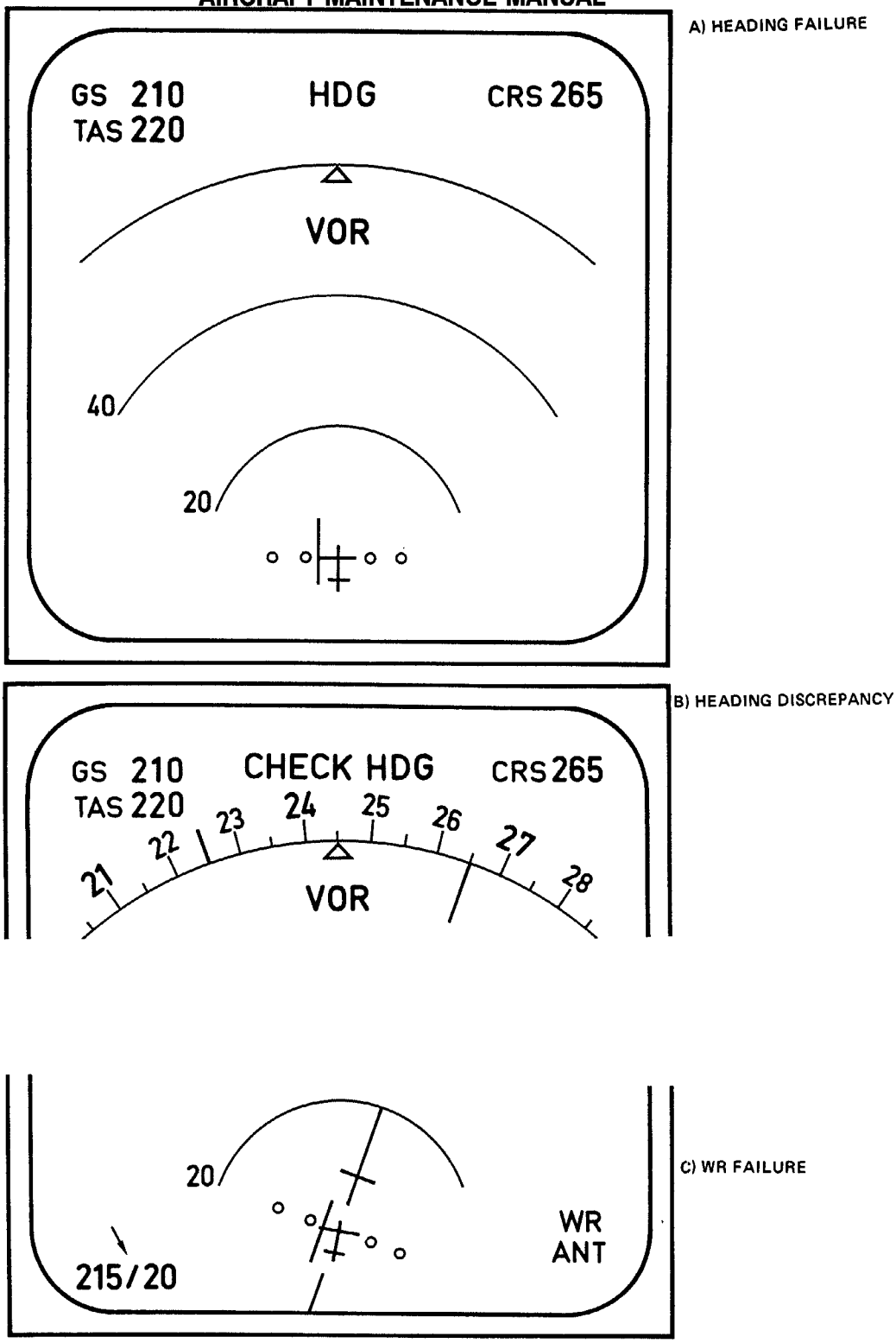
(Ref. Fig. 039)



1 - SELECTED COURSE DIGITAL VALUE
2 - SELECTED COURSE POINTER
3 - GLIDE SLOPE DEVIATION
4 - RADAR ANTENNA TILT SELECTION
5 - AIRCRAFT POSITION (FIXED) AND TRACK
6 - WIND DIRECTION AND SPEED
7 - LATERAL DEVIATION
8 - WR ECHOS
9 - A/C HEADING
10 - SELECTED HEADING - EITHER WITH IN
- OR OUT OF RANGE
11 - TRACK INDEX (IN RELATION WITH A/C SYMBOL 5.)
12 - ILS SELECTED FREQUENCY

BM5 34 70 00 0 CAT0 28 23
DM5

ND - ARC Mode - General Presentation
Figure 039



BM5 34 70 00 0 AF00 15-10
DM5

ND - Arc Mode - Warning Messages
Figure 040

(3)MAP Mode

(a)Heading and course data

Same processing as in ARC mode (Parag. 5.C.2.(a)). A symbol giving runway heading is added on the heading scale in ILS mode. It disappears out of range.

(b)Flight plans

The map displayed on the ND presents the track legs which are ahead of the aircraft. Therefore it is a mobile image which moves with respect to the aircraft symbol (orientated in course direction) represented in the lower part of the display.

The range of the map depends on the position of the range selector switch located on the control panel.

For example, when the switch is in position 60, a zone of 60 NM ahead of the aircraft is displayed in cyan. Graduations are provided at 1/3 and 2/3 of the scale.

After a change of range, RANGE CHANGE message is displayed until the new image is displayed.

In the event of FMC failure, MAP NOT AVAILABLE message is displayed on the ND.

1 Primary flight plan

The primary flight plan, also referred to as active flight plan, is the one which is being flown by the aircraft.

It is represented by white continuous lines.

2 Track leg change

The track leg changes are represented by yellow dashed lines as long as they are not effective.

As soon as they are activated, the dashed lines are replaced by white continuous lines and the initial track legs are cleared.

In case of engine failure, the provisional flight plan is displayed in the same manner.

3 Crosstrack offset

When a crosstrack offset is required, the flight plan is shifted and the new active flight plan is displayed in white.

The offset value is clearly spelt out in the left part of the image as follows :

OFST xxL or R (for an offset to the left or to the right) (XX = offset value).

4 Secondary flight plan

The secondary flight plan may have track legs in common with the active flight plan. These seqments are represented by white continuous lines, like the active flight plan.

The segments which are not common to both flight plans are represented by cyan dashed lines which are replaced by white continuous lines as soon as the secondary flight plan is activated.

5 Trajectory deviations

- Lateral deviation

  The lateral deviation with respect to the flight plan is indicated on the map in nautical miles, on the left of the aircraft symbol.

- Vertical deviation

  A vertical deviation scale is displayed on the righthand side of the map during final approaches, in PROFILE mode only. It gives the

aircraft deviation with respect to the profile computed by the FMC.
(Ref. Fig. 041)
(Ref. Fig. 042)
(Ref. Fig. 043)

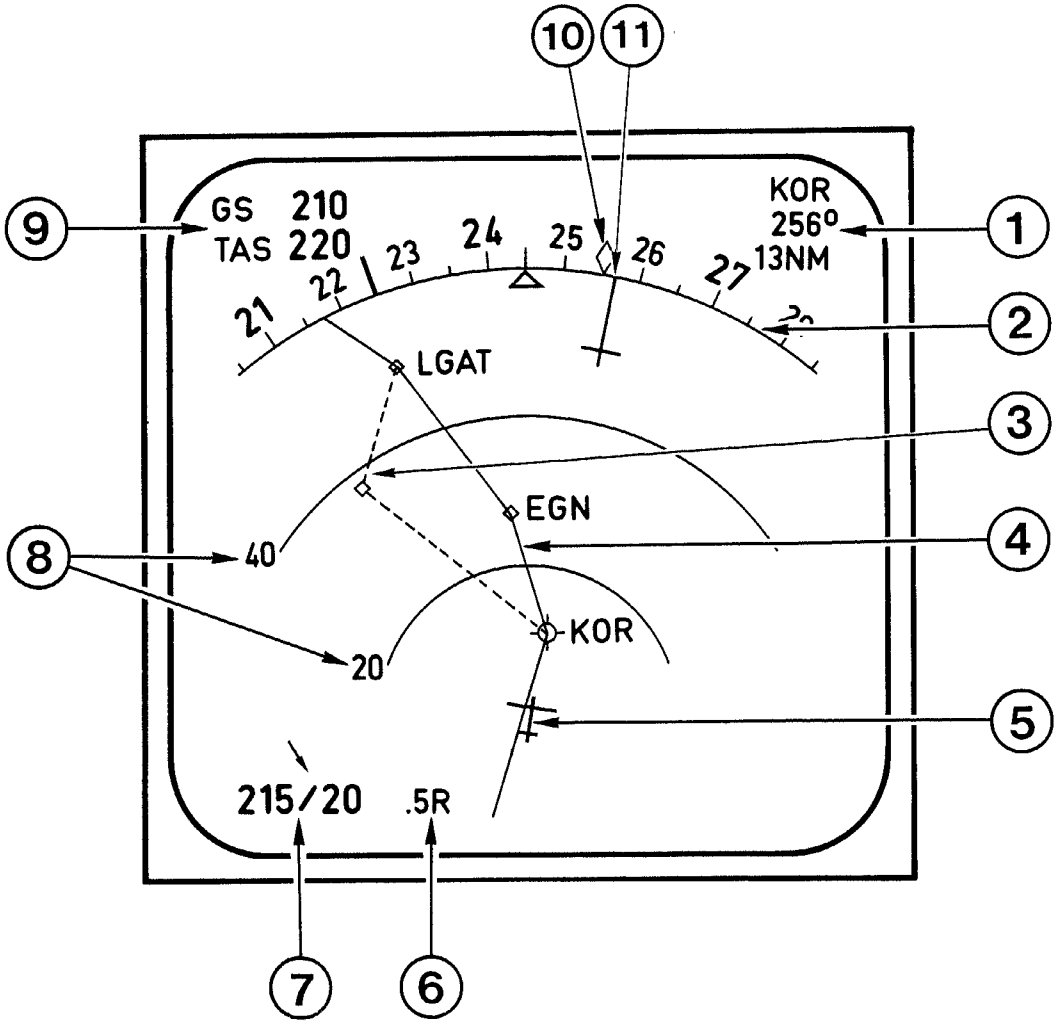
(c)Symbols displayed automatically on the map.
Various symbols are displayed on the map when they lie in the displayed zone ahead of the aircraft.
These symbols are displayed either automatically (it is the case for most of them), or by manual selection from the EFIS control panel.

1 Waypoints
These are represented on the flight plan by a diamond-shaped symbol next to which are indicated the names of the waypoints (Ref. Fig. 044).
The active waypoint (TO waypoint) is displayed in green.
All the others are displayed in white.

2 Departure and destination airports
These are automatically represented when they lie in the zone displayed.
The display is dependent on the range selected and on the runway indication.
- The runway is not indicated
  In this case, the airport is represented by a white star, irrespective of the range selected (Ref. Fig. 044). Its name is mentioned next to the star.
- The runway is indicated
  When a scale of 60, 120 or 240 NM has been selected, the airport is represented by a white rectangle with a vector orientated in the direction of the runway axis.
  The name of the airport and the runway identifier are indicated beside the rectangle.
  When a scale of 15 or 30NM has been selected, the runway itself is displayed to range. In case of discontinuity between the runway and the flight plan, the runway is continued by a white dashed line representing a distance of 14.2 NM.
  The name of the airport and the runway identifier are indicated beside the runway display.

3 Holding patterns - Procedures
The holding patterns and procedures are represented only if they make part of the active flight plan.
- For 60, 120 and 240 NM ranges they are symbolized by white curved lines orientated towards the inboard course and indicating the direction of turn (Ref. Fig. 044).
- For 15 and 30 NM ranges, they are represented to range like the other flight path segments when they are included in the active leg of the flight plan.
  If not, they remain in the form of symbols as for other ranges.

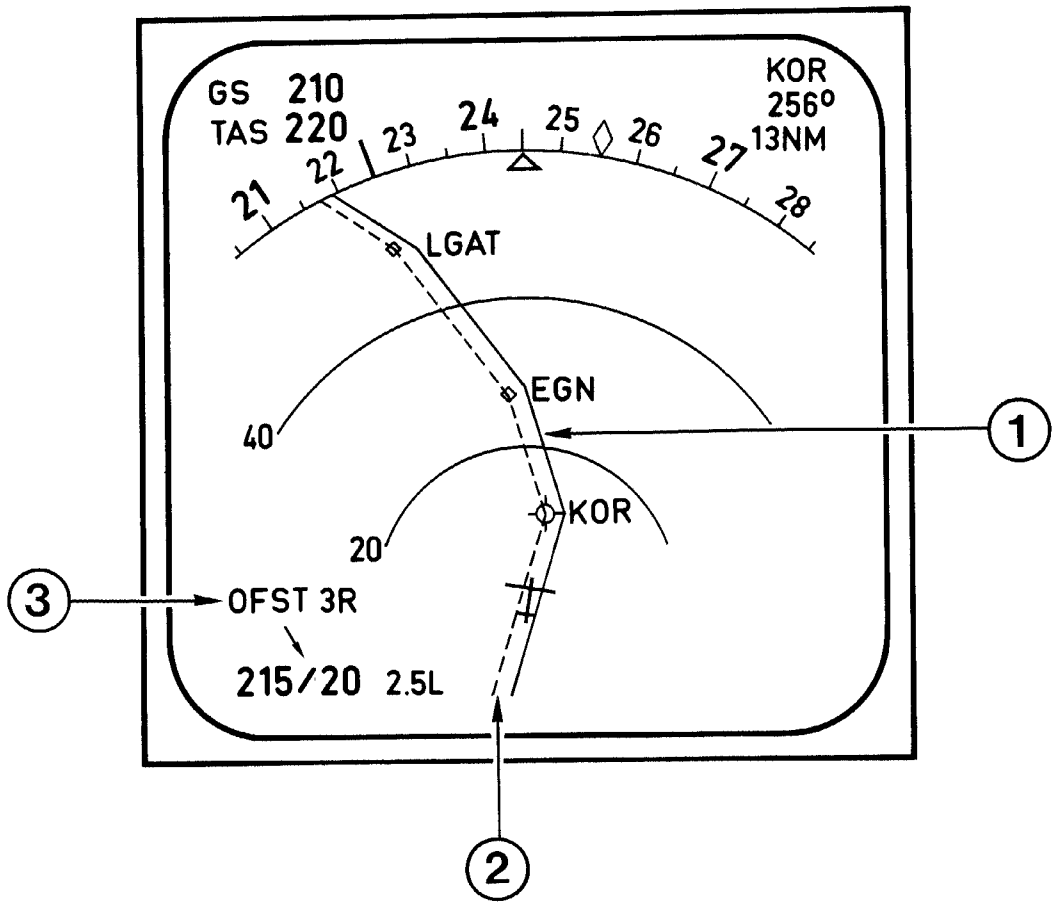
4 Selected altitude intercept point
a PROFILE mode non activated
The selected altitude intercept point is computed by the SGU from the slope followed.
It is displayed on the ND in the form of a yellow arc of a circle.



BM5 34 70 00 0 AGW0 28 23
DM5

1 - ACTIVE WAYPOINT (IDENTIFIER, BEARING, DISTANCE)
2 - HEADING SCALE
3 - TRACK LEG CHANGE OR SECONDARY FLIGHT PLAN
4 - ACTIVE FLIGHT PLAN
5 - AIRCRAFT POSITION (FIXED) AND TRACK
6 - CROSSTRACK DEVIATION
7 - WIND
8 - GEOGRAPHIC SCALE MARKERS
9 - GROUND SPEED AND TRUE AIRSPEED
10 - TRACK INDEX (IN RELATION WITH A/C SYMBOL ITEM 5.)
11 - RUNWAY HEADING

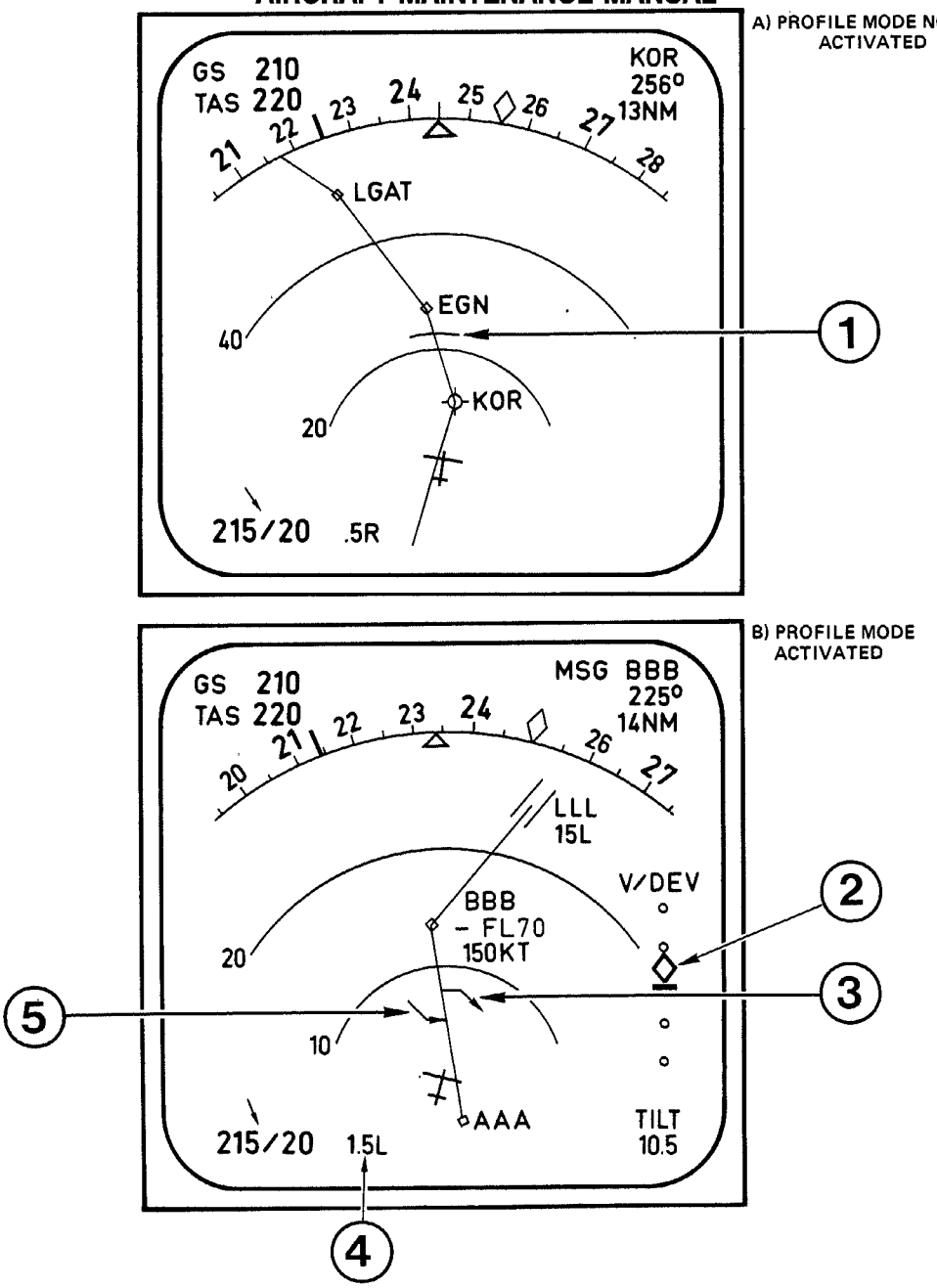
ND - MAP Mode - General Presentation
Figure 041



1 - NEW ACTIVE FLIGHT PLAN
2 - PREVIOUS FLIGHT PLAN
3 - OFFSET VALUE

BM5 34 70 00 0 AHW0 28 23
DM5

ND - MAP Mode - Offset Presentation
Figure 042



1 - ALTITUDE INTERCEPT ARC
2 - VERTICAL DEVIATION (ONLY FOR SOME FWC APPROACHES)
3 - TOP OF DESCENT
4 - CROSS TRACK DEVIATION { X.X.R FOR RIGHT DEVIATION / X.X.L FOR LEFT DEVIATION }
5 - ALTITUDE INTERCEPT POINT
- IF AIRCRAFT ALTITUDE > SELECTED ALTITUDE + 100 Ft
- IF AIRCRAFT ALTITUDE < SELECTED ALTITUDE – 100 Ft
- NO SYMBOLS IF SELECTED ALTITUDE + 100 Ft > AIRCRAFT ALTITUDE > SELECTED ALTITUDE – 100 Ft

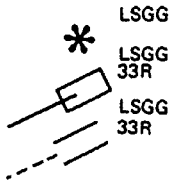
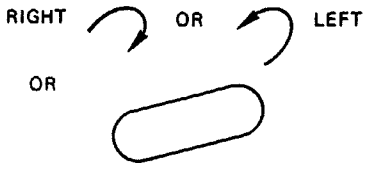
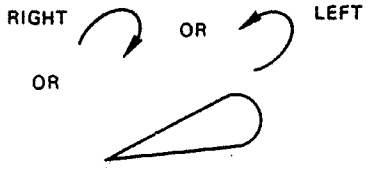
BM5 34 70 00 0 ALW0 28 23
DM5

ND - MAP Mode - Altitude Intercept Point - Top of Descent
Figure 043

b **PROFILE** mode activated
In this case the **FMC** gives the point of the flight plan where the profile intercepts the selected flight level.
The interception point is indicated by a cyan specific symbol the shape of which changes depending on whether the altitude is intercepted in climb or in descent.
The symbol turns amber if the selected altitude is such that the profile can no longer be followed.

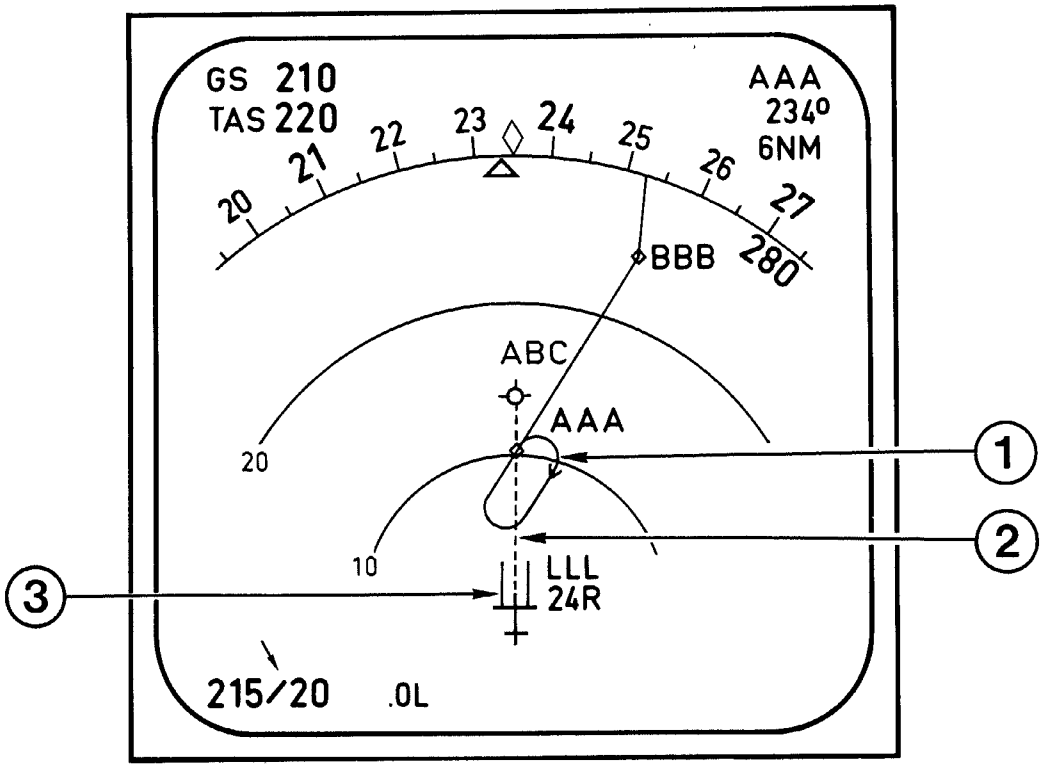
5 Top of descent
The top of descent point is represented by a white symbol which is displayed on the flight plan. It is the point at which the present flight level must be left to initiate the descent . The same symbol is displayed in cyan when a flight level other than the present level is selected.
In this case, two top of descent symbols will be displayed.

6 Tuned navaids
The **VOR DME** or **VOR/DME** stations manually selected by the crew or automatically selected by the **FMC** in autotune are displayed on the map in the form of a cyan symbol with the identifier of the station.
(Ref. Fig. 044)
(Ref. Fig. 045)

SYMBOLS	DRAWING	COLOR
WAYPOINT		WHITE OR GREEN IF TO WAYPOINT
VOR		MAGENTA OR CYAN WHEN TUNED
DME		MAGENTA OR CYAN WHEN TUNED
VOR/DME		MAGENTA OR CYAN WHEN TUNED
NDB		MAGENTA
AIRPORTS		MAGENTA OR WHITE FOR ORIGIN DESTINATION MAGENTA OR WHITE FOR ORIGIN DESTINATION MAGENTA OR WHITE FOR ORIGIN DESTINATION
ALTITUDE INTERCEPT POINT		CYAN
TOP OF DESCENT		WHITE
HOLDING PATTERN		WHITE WHITE OR CYAN OR AMBER
PROCEDURE TURN		WHITE WHITE OR CYAN OR AMBER
TURN LEFT TURN RIGHT		WHITE

BM5 34 70 00 0 AJ00-09-04
DM5

ND - Map Display Symbols
Figure 044



1 - HOLDING PATTERN
2 - RUNWAY CENTERLINE
3 - ORIGIN AIRPORT AND IDENTIFIER

BM5 34 70 00 0 AKW0 28 23
DM5

ND - MAP Mode-Runway Presentation, Flight Plan Discontinuity and Holding Pattern
Figure 045

(d)Symbols displayed manually on the map

The flight crew can present complementary information on the map by selection through pushbutton switches located on EFIS control panel : CSTR, WPT, VOR.D, NDB, ARPT.

Only one function can be selected at a time.

1 CSTR (constraints) function

This function enables all the constraints related to the waypoints, altitude, speed, and time constraints, to be presented on the map.

There are displayed in magenta below the waypoint identifier.

In the case of altitude constraints, the sign which is placed in front of each of them indicates whether the aircraft must fly above or below the level mentioned, example :

+ FL 70 : the aircraft must be at level 70 or above

- FL 70 : the aircraft must be at level 70 or below

FL 70 : the aircraft must be exactly at level 70.

2 WPT (waypoint) function

The waypoints other than those located on the flight plan and their identifiers are displayed on the map in magenta.

3 VOR-D (VOR/DME) function

The VOR DME or VOR/DME stations other than those selected and their identifiers are presented on the map in magenta.

4 NDB (Non Directional Beacon) function

The ADF stations are indicated on the map in magenta.

5 ARPT function

The airports other than those included in the flight plan are indicated on the map in magenta (same display as in the case of departure and destination airports).

(e)Digital data

1 Ground speed and true airspeed

The ground speed and true airspeed are displayed in green in the upper lefthand corner of the image.

The digital value is replaced by dashes when it is not available (no computed data).

In case of failure, the digital value is cleared.

2 Next waypoint

The data concerning the next waypoint is displayed in green in the upper righthand corner of the image.

This data comprises :

- the identifier of the next waypoint
- the heading to reach it
- the distance.

3 Wind data

The wind direction and speed are indicated in green in the lower lefthand corner of the map.

The pointer indicates the wind direction with respect to A/C magnetic heading (wind data come from IRS).

The left digits indicate the wind true direction, the right digits indicate the wind speed (in kts).

(f)Specific messages

(Ref. Fig. 046)

Specific messages can be displayed on the ND to warn the crew.

These are clearly spelt out, or only amber MSG indication is displayed.
The crew shall refer to the FMC CDU to read the message displayed
- If the GPS is installed :
  In case of loss of GPS ;
  Amber GPS PRIMARY LOST and amber MSG indications are displayed at the same time.
  The crew shall refer to the FMC CDU to read the GPS information.

NOTE : These specific messages are available whatever the selected mode (MAP, ROSE, ARC, PLAN).

(g)Radar image

The radar image is displayed on the ND when the transceiver is switched on on the radar control unit.
The echoes and failure warning messages are processed as in Arc mode (See paragraph 2.d.).
(Ref. Fig. 047)
(Ref. Fig. 048)
If the predictive windshear function is activated :
(Ref. Fig. 049)
In case of windshear prediction from the weather radar, two different messages can be displayed :
- W/S : CHANGE MODE ; available in plan or rose mode. This indication informs the crew to switch to map or arc mode.
- W/S : SET RNG 15NM ; available in map or arc mode. This indication informs the crew to switch to 15NM range.

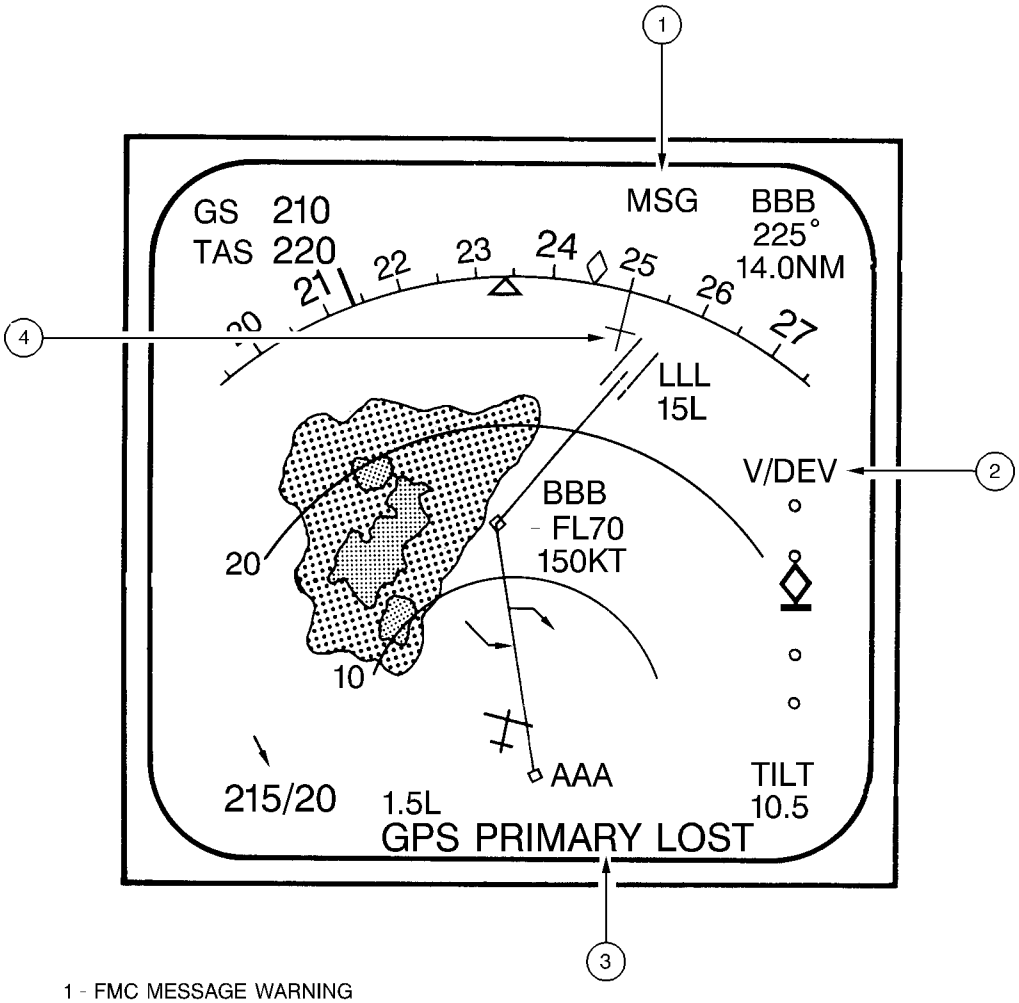
If function is faulty, PRED W/S is displayed in the radar area (right bottom corner of the ND).

R **ON A/C 101-200,

R (h)TERRAIN image thru EGPWS

R The TERRAIN image is displayed on the ND when TERR MODE pushbutton switch is selected ON on panel 402VU.
R The background displayed is the same as in ARC mode (see paragraph 2.(e)).

R **ON A/C ALL



1 - FMC MESSAGE WARNING
"MSG" INDICATION FLASHES WHEN A MESSAGE IS DISPLAYED ON THE FMS CDU (AVAILABLE IN THE FOUR ND MODES)

2 - VERTICAL DEVIATION WITH 400Ft RANGE
FOR GPS APPROACHES (WITH VOR/NAV/ILS SWICH IN NAV POSITION)

3 - FMC MESSAGE WARNING
"MSG" INDICATION FLASHES FOR 9 SECONDS APPROXIMATELY, THEN BECOMES STEADY AND "GPS PRIMARY LOST" INDICATION IS DISPLAYED.

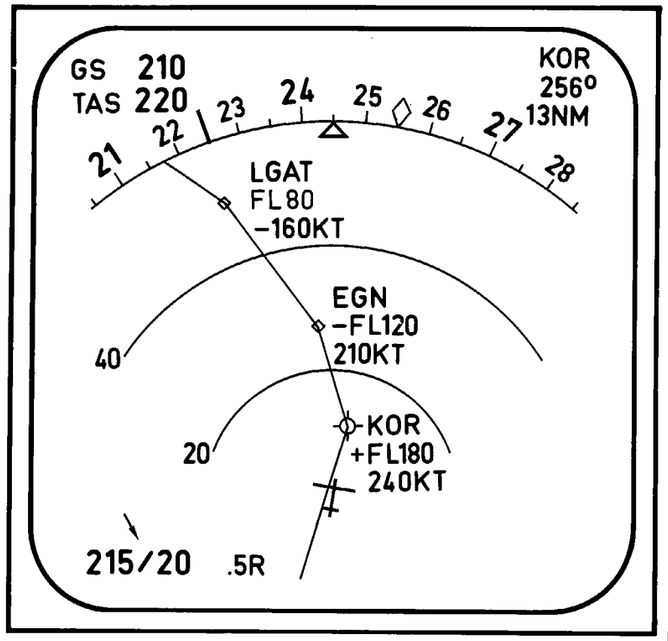
4 - A/C INDEX
INDICATES THE LAST LEG HEADING IN GPS OPERATION FLIGHT (APPROACH CONDITION)

BM5 34 70 00 0 BBM0 01

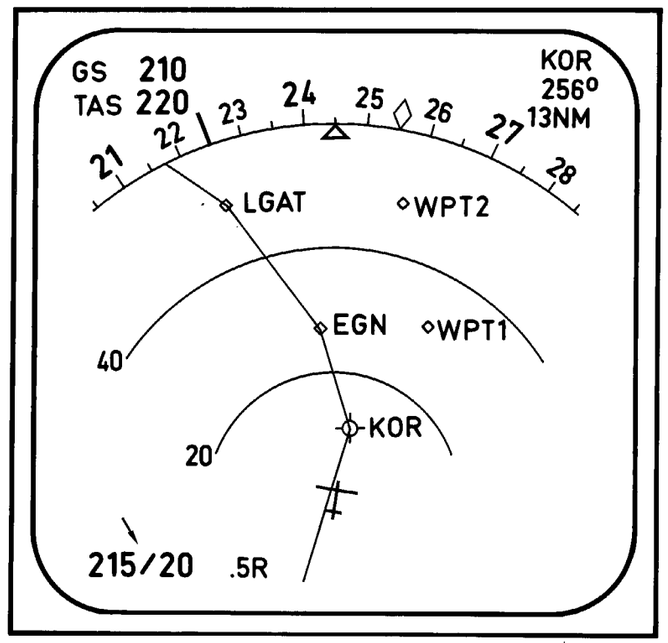
ND - MAP MODE - FMC and GPS Indications
Figure 046

INTENTIONALLY BLANK

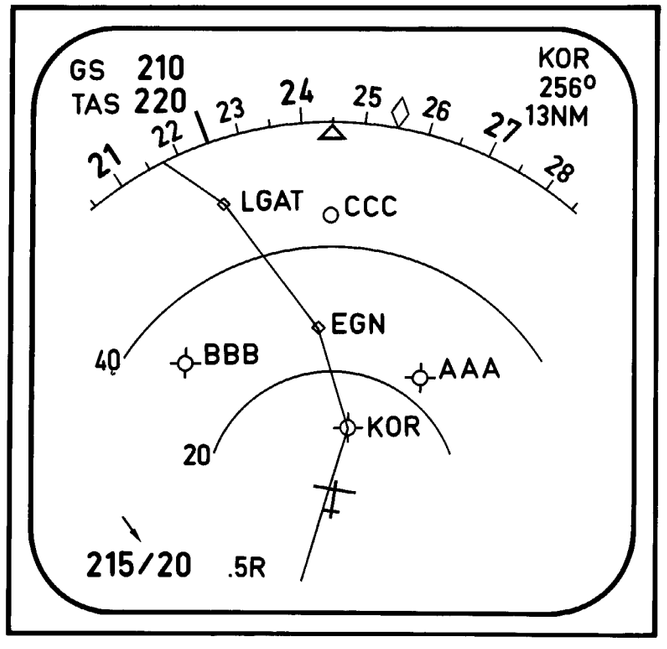
A) CONSTRAINTS FUNCTION



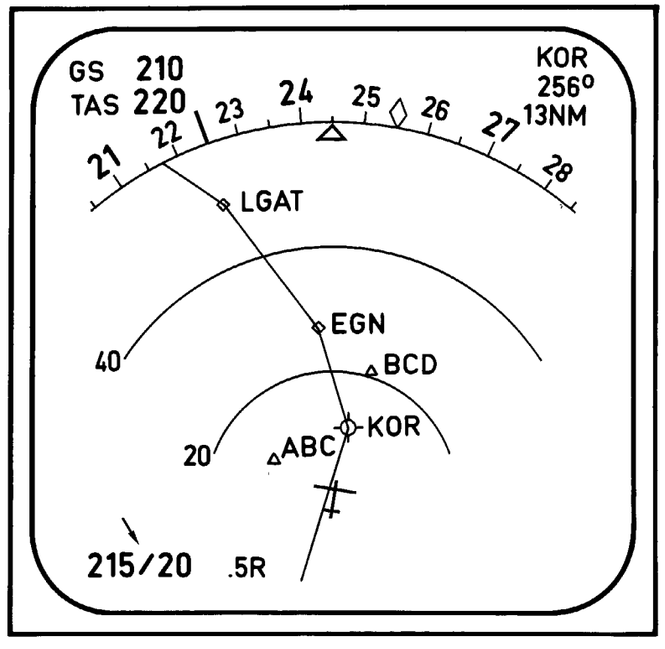
B) WAYPOINTS FUNCTION



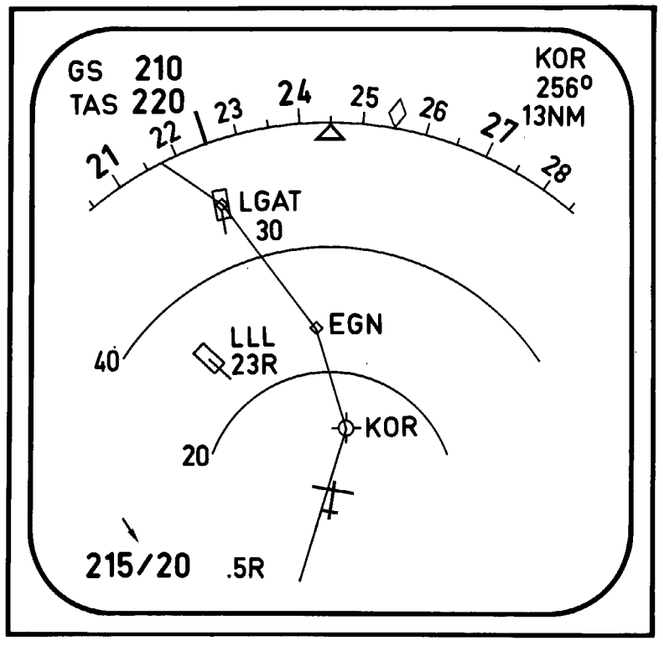
C) VOR/DME FUNCTION



D) NDB FUNCTION

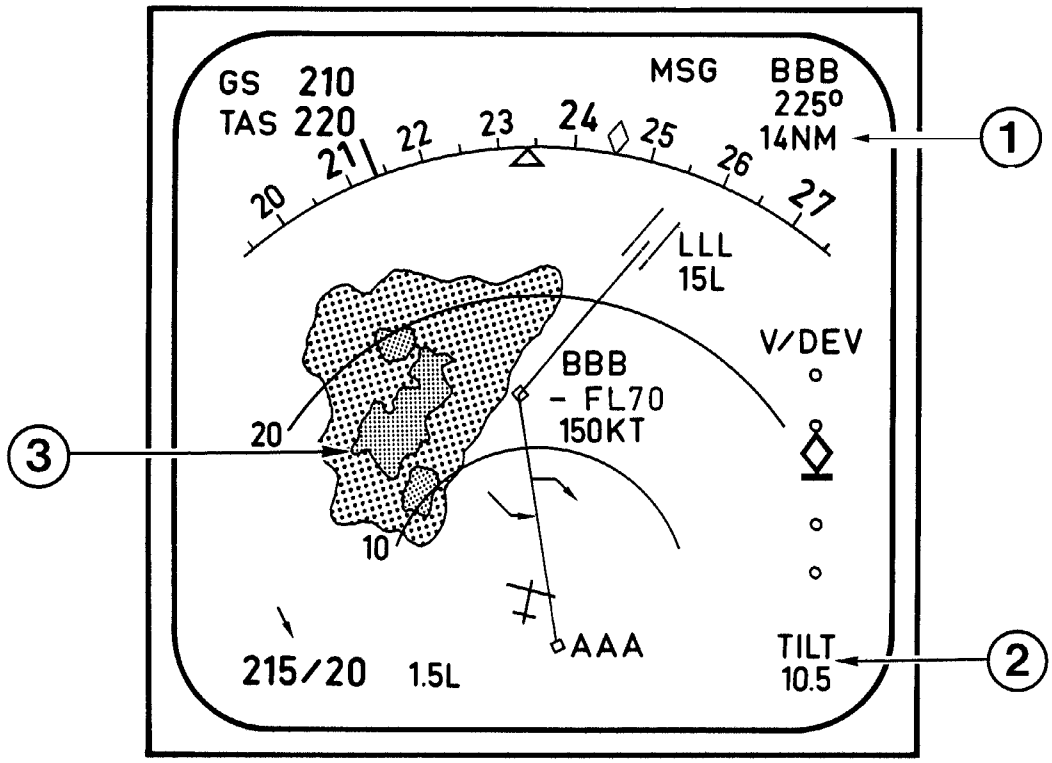


E) AIRPORTS FUNCTION



BM5 34 70 00 0 AMW0 -28 -23
DM5

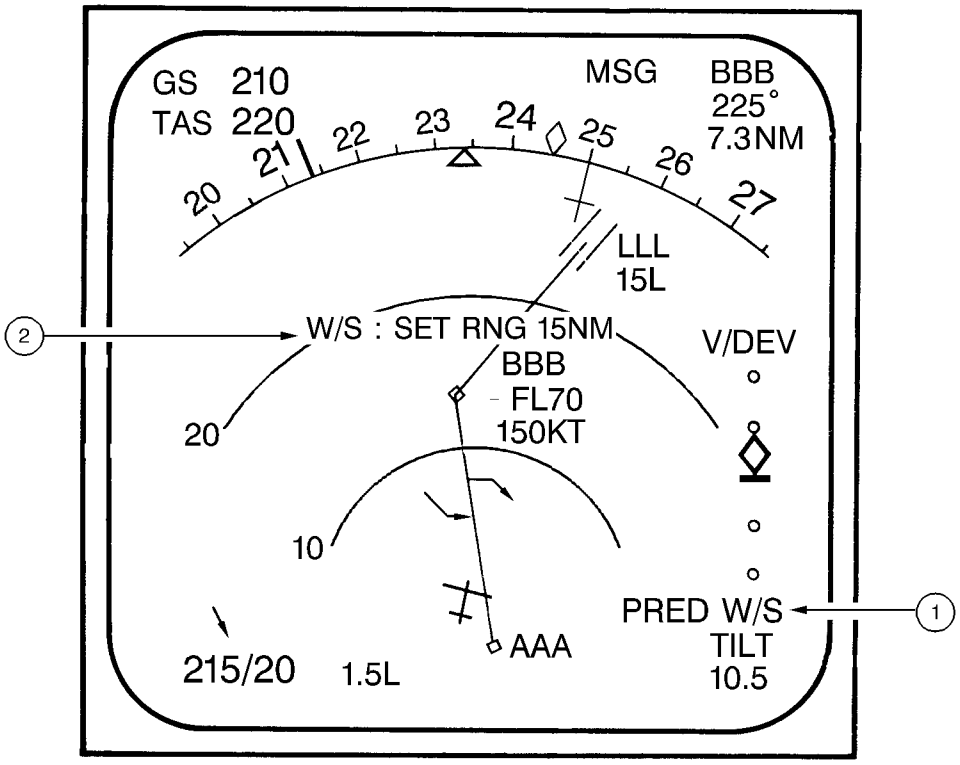
ND - MAP Mode - Selectable Function Display
Figure 047



1 - WR RANGE BETWEEN 0 AND 20NM
2 - WR ANTENNA TILT
3 - WR ECHOS

BM5 34 70 00 0 ANW0 01

ND - Map Mode - WR Data
Figure 048



1 - PRED W/S IS DISPLAYED IN CASE OF PREDICTIVE FUNCTION FAULT

2 - TWO MESSAGES CAN BE DISPLAYED :
W/S CHANGE MODE (ONLY IN PLAN OR ROSE MODE)
W/S SET RNG 15NM (ONLY IN MAP OR ARC MODE)

BM5 34 70 00 0 BDM0 00

ND - Map Mode - Prediction Windshear Data
Figure 049

(4)PLAN mode

The ND image presents a fixed map of the flight plan.
This map is centered on a reference waypoint selected from the FMC CDU and is orientated to true North.
Aircraft position is indicated by a symbol which is pointed in course direction and therefore advances along the flight plan.
In the event of failure, this symbol is replaced by a circle.
The range is selected from the range selector switch located on EFIS control panel : for example, at a scale of 120, the map presents an image with a radius equal to 60 NM.
After a change of range, RANGE CHANGE message is displayed until the new image is displayed.
In the event of FMC failure, PLAN NOT AVAILABLE message is displayed on the ND and the flight plan is cleared.

(a)Reference waypoint

The waypoint which is presented in the center of the map, depends only on the page displayed on the FMC CDU. It is always the second waypoint indicated on this page. In most cases it corresponds to the next waypoint.

(b)Flight plans

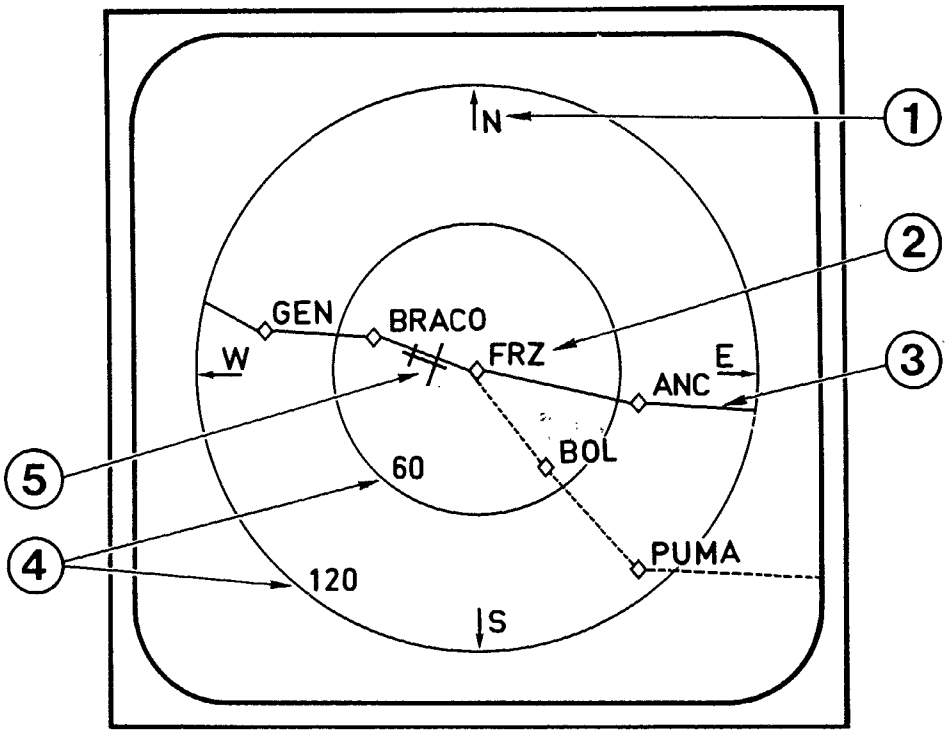
Display is identical to that of MAP mode, paragraph B.3.(b).(1). through B.3.(b).(2).
Trajectory predictions and deviations are not presented.

(c)Symbols automatically displayed on the flight plan

Display is identical to MAP mode display (Ref. para. B.3.(c).(1). through B.3.(c).(3). and B.3.(c).(6).
The selected altitude intercept point and the top of descent are not presented.

(d)Symbols displayed on the flight plan on request

Display is identical to MAP mode display (Ref. para. B.3.(d)).
(Ref. Fig. 050)



1 - TRUE NORTH
2 - REFERENCE WAYPOINT
3 - FLIGHT PLAN
4 - SCALE GRADUATIONS
5 - AIRCRAFT POSITION AND TRACK

BM5 34 70 00 0 APO0-10-04
DM5

ND - Plan Mode
Figure 050

D. Operation in Case of Failure

(1)SGU failure

In the event of SGU1 (or SGU2) failure, the Captain (or First Officer) can switch over to SGU3. This is controlled through EFIS SGU pushbutton switch located on panel 402VU (406VU).
Priority is given to the Captain, i.e. the First Officer cannot switch over to SGU3 if the Captain is utilizing it.
EFIS SGU pushbutton switch is made up of two sections :
- the lower section comes on when the pushbutton switch is pressed on the corresponding panel
- the upper section comes on when the corresponding pushbutton switch on the opposite panel is pressed.

In the event of SGU failure (SGU1, SGU2 or SGU3 when selected), the DUS which are driven by this SGU no longer receive signals. In this case, a diagonal line is displayed on the screen and no ECAM warning appears.
But in case of SGU3 failure only when it is not selected on left ECAM display unit, a warning message appears to inform the crew not to select SGU3.
(Ref. Fig. 051)

**ON A/C 001-100,

(2)DU Failure

In the event of PFD or ND failure, the image which was displayed on the failed DU can be displayed on the DU in operation through PFD/ND XFR command.
This switch controls the inversion of the two images : the image which was displayed on the upper DU is displayed on the lower DU and vice-versa.

(3)Control Panel Failure

In the event of a control panel failure, the PFD image does not change. DH and FPA values are lost and the corresponding failure warning messages come into view.
ILS mode is then compulsory.
The ND automatically switches to MAP mode, with a range of 30Nm.

**ON A/C 101-200,

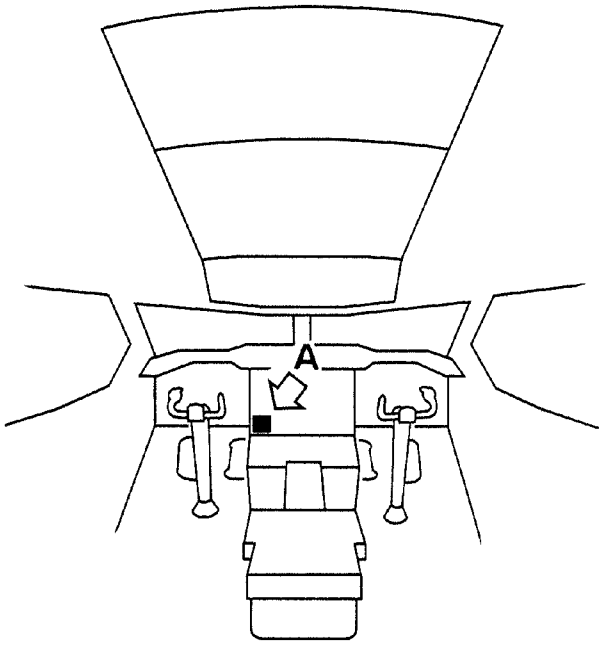
(2)DU failure

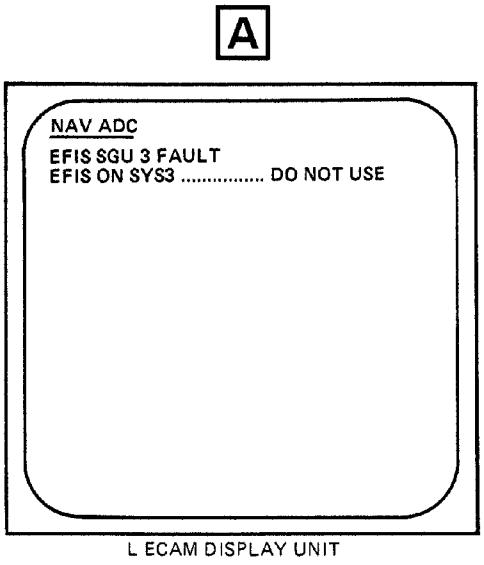
In the event of PFD failure, the image which was displayed on the failed DU will be displayed on the lower DU (by auto-switching).

(3)Control panel failure

In the event of a control panel failure, the PFD image does not change. DH and FPA values are lost and the corresponding failure warning messages come into view.
ILS mode is then compulsory.
The ND automatically switches to MAP mode, with a range of 30Nm.

**ON A/C ALL





L ECAM DISPLAY UNIT

BM5 34 70 00 0 TAQ0 00

EFIS SGU3 Failure - ECAM warnings
Figure 051

E. Operation in Test

(1)Maintenance test

The pushbutton switches located on the maintenance panel allow to start different equipment activities when the aircraft is on ground.

(a)DISPLAYS TEST

Engagement of this pushbutton switch initiates the following :

- Symbol Generator Units power on test
- Display Units test pattern generation.

The test pattern, generated by the SGUs, allows to check the main performances of the display units (convergence, linearity...) (Ref. Fig. 052)

During the power on test, additional to the test pattern, the following text is written on the display units :

```
          SGUn        IN PROGRESS
        (white)          (amber)
```

After completion of the test

```
          SGUn         NORM
        (white)       (green)
```

or

```
          SGUn         FAULT (xxxxx)
        (white)          (amber)
```

is written on the DUs.

n = 1, 2, 3 indicates which SGU generates the image,

xxxxx gives the internal SGU failure code in hexadecimal characters.

To test SGU 3 it has to be configured to either the Captain's or the First Officer's instruments by pressing the associated EFIS SGU/SYS 3 pushbutton switch on one switch panel.

(b)INPUT TEST

Engagement of this pushbutton switch initiates a validity test of all ARINC 429 input buses wired to the SGU.

The PFD will present a list of all buses failed (used label missing, label with SSM equal to failure etc.) (Ref. Fig. 053).

When there is no failed bus the text ;

```
     SGUn        NORM    (n = 1, 2, 3) will be written on the screen.
   (white)     (green)
```

NOTE1 : This test does not indicate that input sensors have failed but only shows that some data are missing for EFIS processing.

NOTE2 : SGU 1 tests FMC 1 input, SGU 2 tests FMC2 input and SGU 3 tests FMC 1 and FMC 2 inputs.

**ON A/C ALL

(c)BITE memory indication

The SGUs have a non volatile memory in which possibly equipment failures could be recorded. (SGU failures, DU failure input buses failures).

Each time when there is a new event which leads to an entry into the BITE memory a ground signal illuminates the LOAD legend within the BITE/DSPL pushbutton switch.

Engagement of this pushbutton switch on ground initiates the writing of the BITE memory contents of the SGUs.
- On the PFD (Ref. Fig. 054) (Part A).
  Failures which have occurred during the last flight are displayed in clear.
- On the ND (Ref. Fig. 054) (Part B).
  Failures which have occurred during the five preceding flights during which an anomaly was present are displayed in coded form (Ref. Fig. 055)

(2)Test of the Attitude Comparison
This test is generated from the EFIS control panel (mode switch in TEST position). The attitude values transmitted to the FWC are purposely false so as to check that the FWC transmits a signal which is displayed on the PFD ("check Att." message).

(3)Test of lights and display window of the EFIS control panel
This test is generated from the same switch used for test of the attitude comparison. When this switch is in TEST position, all pushbutton switch lights come on and 888 is displayed.

**ON A/C ALL

6. Interfaces

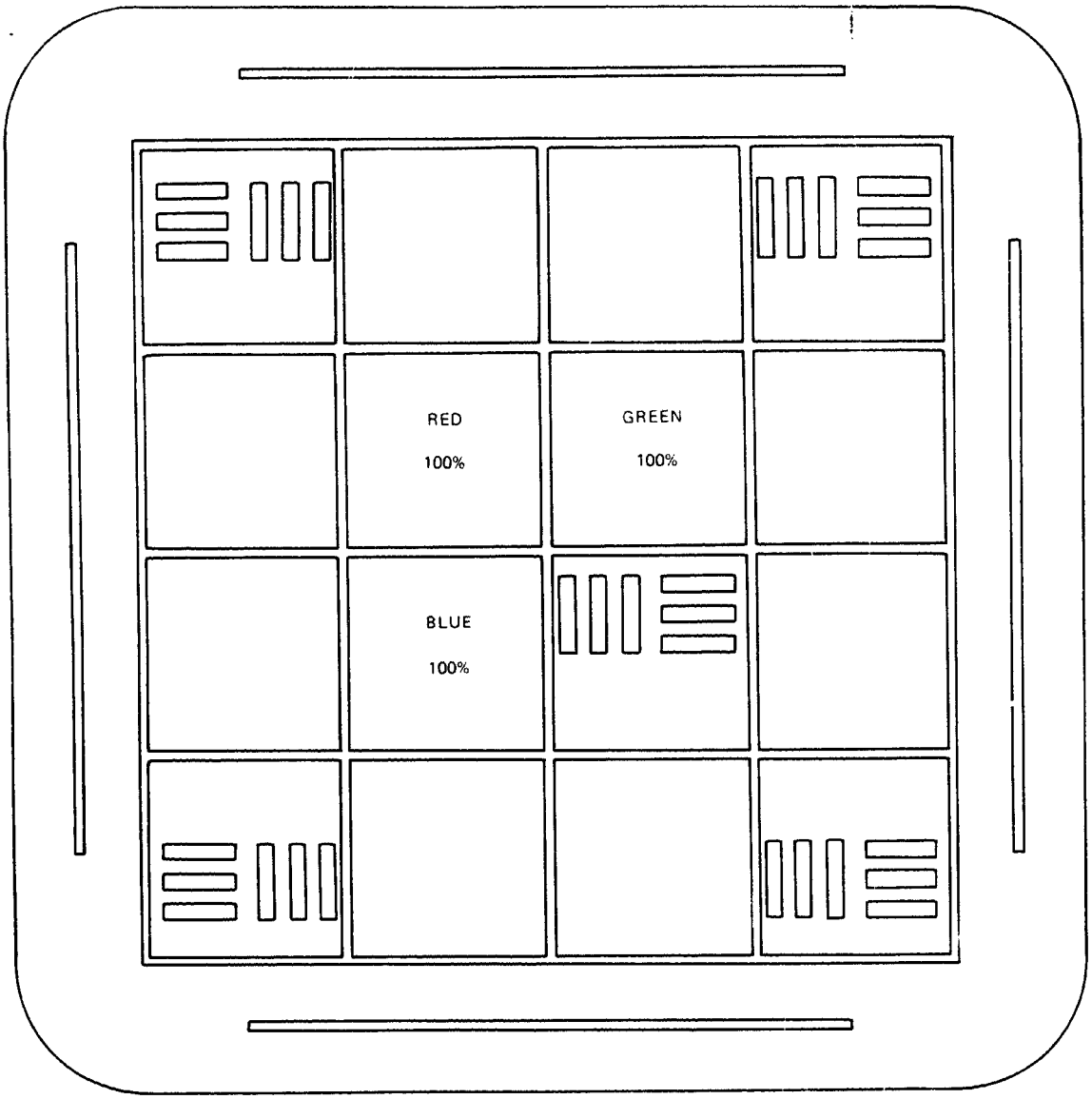
A. General

The system utilizes the following types of interconnections :
- ARINC 429 bus lines, through which most of the data processed by the SGUs are transmitted.
- ARINC 702 bus lines between FMC and SGU
- ARINC 708 bus lines between radar and SGU
- discrete signals used for specific switchings and controls
- analog signals for DU control

B. Symbol Generator Unit Interfaces

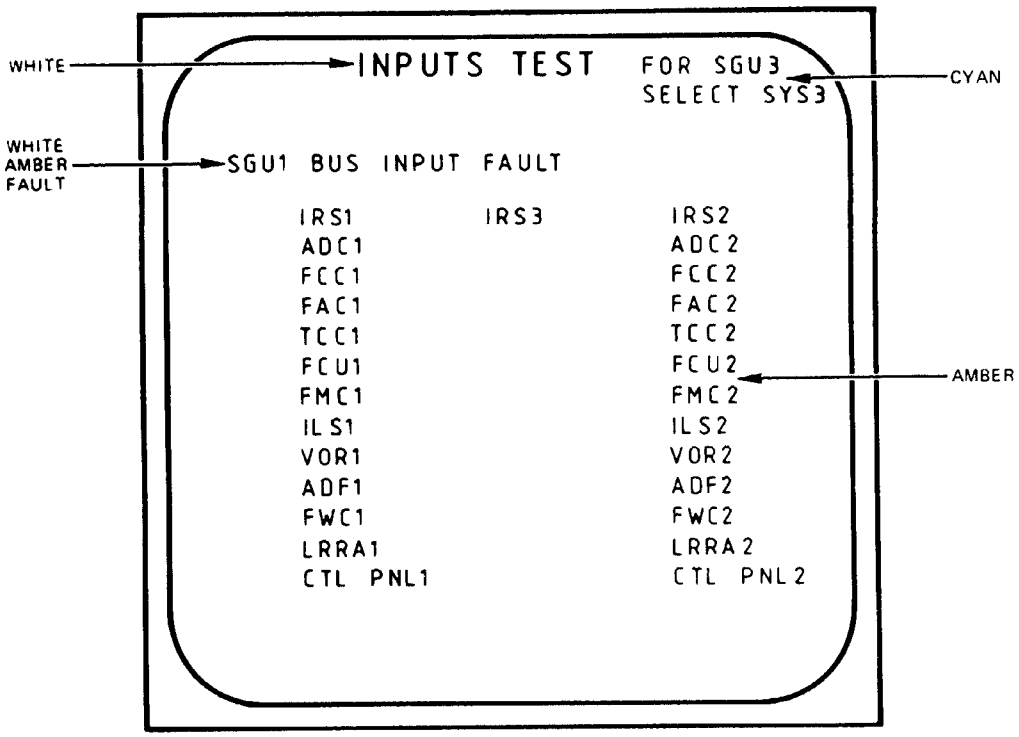
This paragraph contains :
- a list of buses used by each SGU
- a list of symbols with corresponding labels
- a description of radar/SGU bus
- a description of FMC/SGU bus
- a description of SGU output buses
- a list of SGU input and output discretes.

(1)ARINC 429 inputs
SGU1 supplies data to the Captain's instrument (PFD1 and ND1) using data from side 1 sensors : IRS1, ADC1, FMC1, radio altimeter 1 etc...
SGU2 supplies data to the F/O's instrument (PFD2 and ND2) using data from side 2 sensors : IRS2, ADC2, FMC2 etc...
The configuration of SGU3 input buses depends on SGU operation :
- SGU3 in standby : it does not control any display, but nevertheless computes all data necessary for display on the Captain's instruments.
- SGU3 replacing SGU1
- SGU3 replacing SGU2.



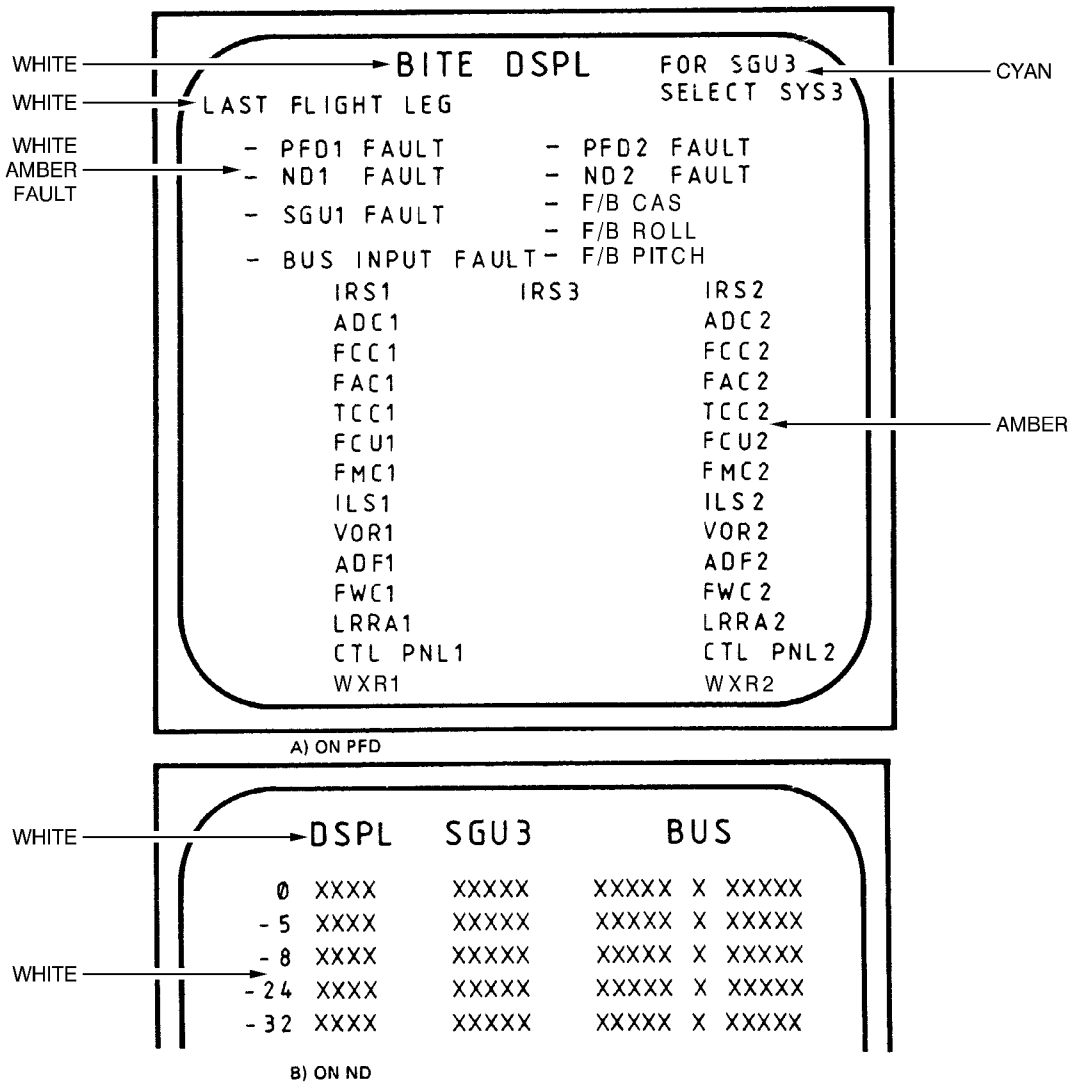
8M5 34 70 00 0 ASQ0 09 04
DM5

Test Pattern
Figure 052



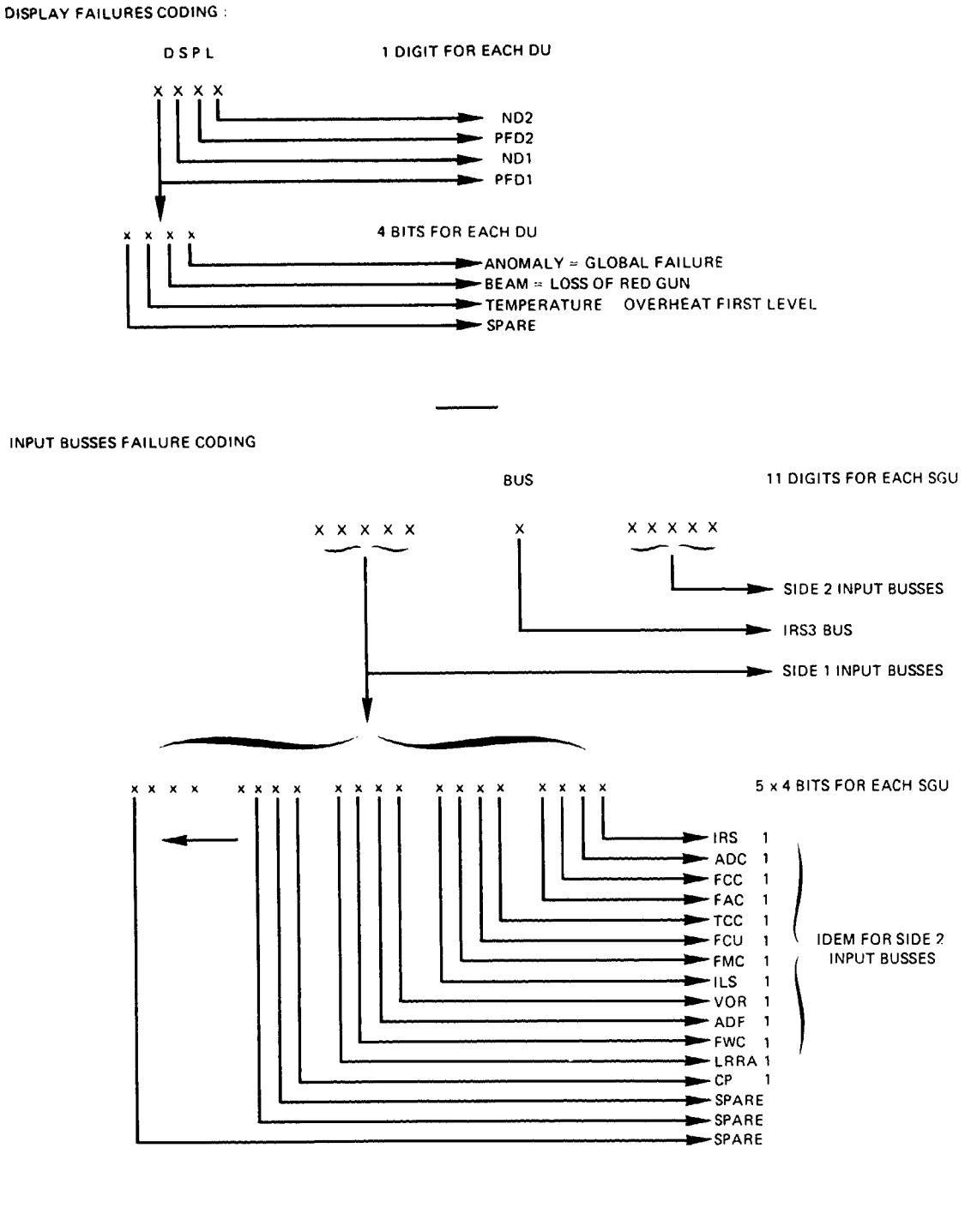
BM5 34 70 00 0 ATQ0 09 04
DM5

PFD - Input Bus Test
Figure 053



BM5 34 70 00 0 BUQ0 00

Content of the **BITE** memory
Figure 054



BM5 34 70 00 0 AVQD 09 04
DM5

BITE memory Coding
Figure 055

Table 10 shows the various buses connected to each SGU and indicates those which are used in normal operation (N) or after reconfiguration (A). Labels used on ARINC 429 input buses are shown in the list of symbols

- Automatic reconfigurations

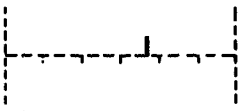
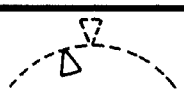
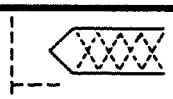
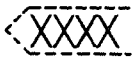
In the event that the SGU no longer receives data from the bus it is utilizing (or receives it with a warning signal), it will automatically read the other bus.

It will return to the first bus if it becomes valid again.

This type of reconfigurations concerns the Radio Altimeter, FWC and Radar buses only.

(Ref. Fig. 056)
(Ref. Fig. 057)
(Ref. Fig. 058)
(Ref. Fig. 059)
(Ref. Fig. 060)
(Ref. Fig. 061)
(Ref. Fig. 062)
(Ref. Fig. 063)
(Ref. Fig. 064)

[PFD]

SYMBOL	DISPLAY	LABEL	SOURCE
MAGNETIC HEADING SCALE		320	IRS
SELECTED HEADING		101	FCU
ROLL INDEX		325	IRS
SIDE SLIP INDEX		332	IRS
PITCH SCALE		324	IRS
FLIGHT PATH VECTOR - DRIFT - SLOPE		321 322	IRS
FLIGHT PATH TARGET SELECTED COURSE OR RUNWAY HEADING - SLOPE		100 OR 105 273	VOR OR ILS EFIS C.P.
FD BARS - PITCH ROLL		140 141	FCC
ROLL OUT GUIDANCE		143	FCC
BARO ALTITUDE		203 204 220	ADC
SELECTED ALTITUDE		102	FCU

BM5 34 70 00 0 AW00 09 04
DM5

EFIS Displays - List of Symbols - Board 1
Figure 056

SYMBOL	DISPLAY	LABEL	SOURCE
ILS/DME DISTANCE	DME XX.X	154	FMC
MACH	XXX	205	ADC
COMPUTED AIRSPEED	200 180	206	ADC
SPEED TENDENCY		262	FAC
MANEUVERING SPEED		265	FAC
SELECTED SPEED		103	FCU or FMC
FLAP RETRACTION MINIMUM SPEED	F	263	FAC
SLAT RETRACTION MINIMUM SPEED	S	264	FAC
V1	1	073	FMC

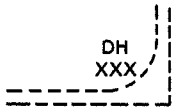
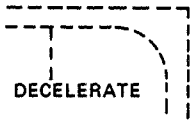
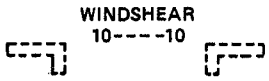
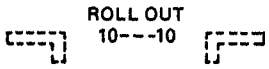
BM5 34 70 00 0 AXO0 09 04
DM5

EFIS Display - List of Symbols - Board 2
Figure 057

SYMBOL	DISPLAY	LABEL	SOURCE
MAXIMUM ALLOWABLE AIRSPEED		207	FAC
STICK SHAKER SPEED		256	FAC
MINIMUM SELECTABLE SPEED		245	FAC
DFA MESSAGES	FLAPS	273	TCC
FLIGHT MODE ANNUNCIATOR AUTOTHROTTLE MODE	XXX	274	TCC
AP LONGIUDINAL MODE	XXX	274/273/275	FCC
AP LATERAL MODE	XXX	275/273/274	FCC
CAPABILITIES	XXX	146/273	FCC
ENGAGEMENTS	XXX	146	FCC
G/S DEVIATION		174	ILS

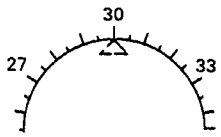
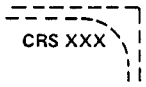
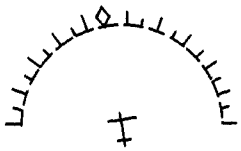
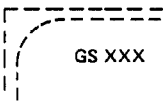
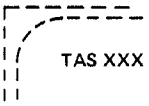
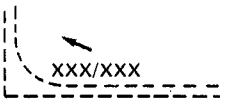
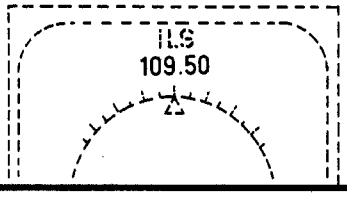
BM5 34 70 00 0 AYQ0 09-04
DM5

EFIS Display - List of Symbols - Board 3
Figure 058

SYMBOL	DIPSLAY	LABEL	SOURCE
LOC DEVIATION		173	ILS
RADIO HEIGHT		164	RA
DECISION HEIGHT		170	EFIS C.P.
SPECIFIC MESSAGES		270	FMC
		270	FMC
		274	FAC
		146	FCC

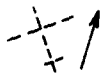
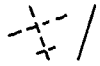
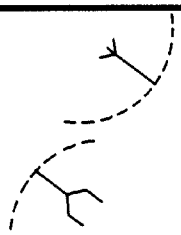
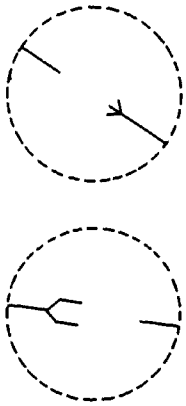
BM5 34 70 00 0 AZS0 24 04
DM5

EFIS Displays - List of Symbols - Board 4
Figure 059

SYMBOL	DISPLAY	LABEL	SOURCE
MAGNETIC HEADING SCALE		320	IRS
SELECTED HEADING		101	FCU
SELECTED COURSE OR RUNWAY HEADING		100 OR 105	VOR OR ILS
SELECTED COURSE OR RUNWAY HEADING		100 OR 105	VOR OR ILS
MAGNETIC TRACK		317	IRS
GROUND SPEED		012	IRS
TRUE AIRSPEED		230	ADC
WIND DATA ARROW DIRECTION/SPEED		316 + {313 / 317} 316 + 315	IRS
SELECTED FREQUENCY (ILS MODE ONLY)		033	ILS

BM5 34 70 00 0 AAB0 00

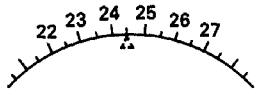
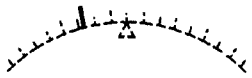
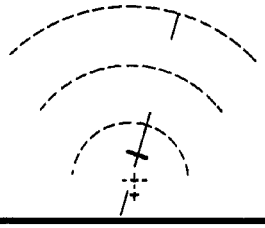
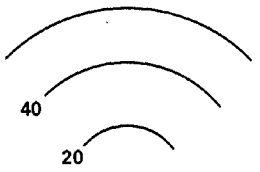
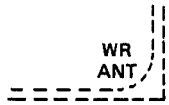
EFIS Displays - List of Symbols - Board 5
Figure 060

SYMBOL	DISPLAY	LABEL	SOURCE
VOR DEVIATION		100 222	VOR
LOC DEVIATION		173	ILS
G/S DEVIATION		174	ILS
ADF 1 ADF 2		162 162	ADF 1 ADF 2
A/C FITTED WITH ONLY ONE ADF ADF 1 ADF 2		162	ADF

8M5 34 70 00 0 ABR0 09 04
DM5

EFIS Displays - List of Symbols - Board 6
Figure 061

ND - ARC MODE

SYMBOL	DISPLAY	LABEL	SOURCE
MAGNETIC HEADING SCALE		320	IRS
SELECTED HEADING		101	FCU
SELECTED COURSE OR RUNWAY HEADING		100 OR 105	VOR OR ILS
GEOGRAPHIC SCALE		273	EFIS C.P.
WR MESSAGES		055	WR
SELECTED FREQUENCY (ILS MODE ONLY)		033	ILS

BM5 34 70 00 0 AAW0 15

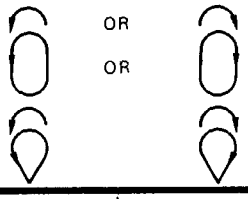
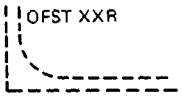
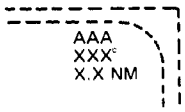
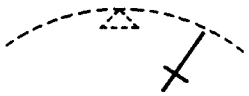
EFIS Displays - List of Symbols - Board 7
Figure 062

ND - MAP & PLAN MODES

SYMBOL	DISPLAY	LABEL	SOURCE
FLIGHT PLAN WAYPOINT OR ACTIVE WAYPOINT	ABC	330 070	FMC
TUNED NAVAID TUNED VOR TUNED DME TUNED VOR/DME	BCD CDE DEF	030 130 150	FMC
NON-DIRECTIONAL BEACON	EFG	154	FMC
AIRPORTS - NO SPECIFIED RUNWAY SPECIFIED RUNWAY - TERMINAL ZONE	LSGG LSGG 33R LSGG 33R	270 OR 170 254 054 - 340	FMC
ACTIVE FLIGHT PLAN PROVISIONAL FLIGHT PLAN SECONDARY FLIGHT PLAN PRE NAV ENGAGE PATH		100 300 040 140	FMC
ALTITUDE INTERCEPT ARC		322 102 203 204 220	IRS FCU ADC
ALTITUDE INTERCEPT POINT	OR	060 OR 061	FMC
TOP OF DESCENT		062 OR 063	FMC

BM5 34 70 00 0 ADR0 09 04
DM5

EFIS Displays - List of Symbols - Board 8
Figure 063

SYMBOL	DISPLAY	LABEL	COURSE
HOLDING PATTERN IN ROUTE TERMINAL ZONE PROCEDURE TURN IN ROUTE TERMINAL ZONE		034 (L) 354 (R) 134 (L) 234 (R)	FMC
TURN DIRECTION LEFT TURN DIRECTION RIGHT		156 157	FMC
CROSSTRACK OFFSET		020	FMC
OFFSET VALUE R TO THE RIGHT L TO THE LEFT		160	FMC
WAYPOINT IDENT BEARING DISTANCE		356, 357 115 001	FMC
CROSSTRACK DEVIATION R TO THE RIGHT L TO THE LEFT		116	FMC
VERTICAL DEVIATION		117	FMC
RUNWAY HEADING		105	ILS

BMS .14 70 00 0 AERO 09 04
DM5

EFIS Displays - List of Symbols - Board 9
Figure 064

Table 10

INPUT SENSORS		ARINC 429 Bus wired on SGU 1	2	3	ARINC 429 Bus processed by SGU 1	2	3	3/1	3/2	REMARKS
AHRS IRS	1	x		x	N or		N	N		Selection from pilot's panels for SGU 3
	2		x	x		N or			N	
	3	x	x	x	A	A	A	A	A	
ADC	1	x	x	x	N or	A or	N	N	A	Selection from pilot's panels
	2	x	x	x	A	N	A	A	N	
FCC	1	x	x	x	N or	N or	N	N	N	Selection from pilot's panels
	2	x	x	x	N	N	N	N	N	
FMC	1	x		x	N		N	N		
	2		x	x		N			N	
FMC	1	x	x	x	N	A	N	N	A	Selection from pilot's panels
	2	x	x	x	A	N	A	A	N	Aircraft fitted with switching
TCC	1	x	x	x	N or	N or	N	N	N	
	(2)	x	x	x	A	A	A	A	A	If aircraft fitted with 2TCCs
FAC	1	x	x	x	N	A	N	N	A	Selection from pilot's panels Same pushbutton switches as ADC
	2	x	x	x	A	N	A	A	N	
FCU (AFS CP)	1	x		x	N		N	N		
	2		x	x		N			N	
VOR	1	x		x	N		N	N		
	2		x	x		N			N	
VOR	1	x	x	x	N	A	N	N	A	Selection from pilot's panels
	2	x	x	x	A	N	A	A	N	Aircraft fitted with switching
ILS	1	x	x	x	N	N	N	N	N	ILS 1 ---> ND2 and PFD1
	2	x	x	x	N	N	N	N	N	ILS 2 ---> ND1 and PFD2
ILS	1	x	x	x	N	A	N	N	A	ILS 1 ---> PFD1, ND1

INPUT SENSORS		ARINC 429 Bus wired on SGU 1	2	3	ARINC 429 Bus processed by SGU 1	2	3	3/1	3/2	REMARKS
	2	x	x	x	A	N	A	A	N	ILS 2 ---> PFD2, ND2 Selection from pilot's panels Aircraft fitted with switching
RA	1	x	x	x	N or	A or	N	N	A	Automatic selection
	2	x	x	x	A	N	A	A	N	
ADF	1	x	x	x	N	N	N	N	N	
	2	x	x	x	N	N	N	N	N	
FWC	1	x	x	x	N or	A or	N	N	A	Automatic selection
	2	x	x	x	A	N	A	A	N	
WR	1	x	x	x	N or	N or	N	N	N	- If aircraft fitted with 2 WR special ARINC 453 Bus-Automatic selection
	(2)	x	x	x	A	A	A	A	A	
FNCP	1	x		x	N		N	N		
	2		x	x		N			N	

N = Normal A = Alternate

- Manual reconfigurations

IRS, ADC/FAC, FCC, VOR (in option), ILS (in option) and FMC (in option) switchover is manually controlled through illuminated double-legend pushbutton switches located on L and R instrument panels (see paragraph 4.D.2.(b)).

(a) IRS input

SGU1 receives data from IRS1 and 3. It normally operates from IRS1 but can be switches over to IRS3 after reception of a select discrete by means of the Captain ATT HDG pushbutton switch.

SGU2 receives data from IRS2 and 3.

It normally operates from IRS2 but can be switched over to IRS3 after reception of a select discrete by means of the F/O ATT HDG pushbutton switch.

This switchover is only possible when SGU1 is not operating from IRS3, as the Captain's SGU has priority.

SGU3 receives IRS1, 2 and 3.

- In standby mode, or when switched over to Captain's side, it operates like SGU1.
- When switched over to First Officer's side, it operates like SGU2.

(b) ADC inputs

Each SGU receives data from both ADCs. SGU1 normally operates from ADC1 but it can be switched over to ADC2 after reception of a select discrete by means of the Captain ADC INST. pushbutton switch.

Switchover is inhibited if the First Officer has already selected an ADC switchover.

SGU2 normally operates from ADC2 but it can be switched over to ADC1 after reception of a select discrete by means of the F/O ADC INST pushbutton switch. Switchover is inhibited when the Captain has already selected an ADC switchover.

SGU3 operates like SGU1 when it is switched over to Captain's side or when in standby. It operates like SGU2 when it is switched over to First Officer's side.

NOTE : FAC switching is also controlled through ADC select switches.

(c) FCC inputs

Each SGU receives both FCC buses.

It operates from either bus, depending on the engagement status and on select discretes by means of the Captain and F/O FD pushbutton switches and by means of the Captain and F/O FD/FPV switches.

The tables below show the bus selection logic for SGU1 and SGU2. SGU3 operates like SGU1 or SGU2, depending on to which side it is switched over.

1 Bus selection for FD bars display

CAPT FD	F/O FD	SGU1	SGU2
OFF	OFF	FCC1	FCC2
ON	OFF	FCC2	FCC2
OFF	ON	FCC1	FCC1
ON	ON	-	-

CAPT FD	F/O FD	SGU1	SGU2

2 Bus selection for mode and capability display
SGU1

SWITCH OVER FD/ FPV/OFF	SYST 2 (CAPT FD)	FD1 ENG Bit 13 (146) FCC1	FD2 ENG Bit 13 (146) FCC2	CMD1 ENG Bit 12 (146) FCC1	CMD2 ENG Bit 12 (146) FCC2	BUS SELECTION
INDIF-FERENT	INDIF-FERENT	INDIF-FERENT	INDIF-FERENT	1	INDIF-FERENT	FCC1
INDIF-FERENT	INDIF-FERENT	INDIF-FERENT	INDIF-FERENT	0	1	FCC2
FD	OFF	1	INDIF-FERENT	0	0	FCC1
FD	ON	INDIF-FERENT	1	0	0	FCC2
INDIF-FERENT	OFF	0	1	0	0	FCC2 (Note 1)
INDIF-FERENT	ON	1	0	0	0	FCC1 (Note 1)
FPV or OFF	OFF	1	INDIF-FERENT	0	0	FCC1 (Note 1)
FPV or OFF	ON	INDIF-FERENT	1	0	0	FCC2 (Note 1)

NOTE 1 : In these cases there is no display of modes, capabilities and loss of roll out function. However, the bus selected is used for reading the modes enabling automatic switching from FPV to FD mode.

SGU2
The logic is identical to that of SGU1.
Indices 1 and 2 must be permuted.

(d)TCC inputs

Each SGU receives data from both TCCs. Only one TCC operates at a time; the other is in standby.

The SGUs select TCC1 or TCC2 input, depending on the state of two TCC select discretes, one from TCC1 and one from TCC2 :

L TCC select	R TCC select	Bus selected
open	open	/
28V	open	TCC1
open	28V	TCC2
28V	28V	TCC1

The SGUs use TCC bus for reading the autothrottle engagement status and displaying modes.

(e)FAC input

Each SGU receives data from both FACs.

- SGU1 normally operates from FAC1 but it can be switched over to FAC2 after reception of a select discrete by means of the Captain ADC INST pushbutton switch.
- SGU2 normally operates from FAC2 but it can be switched over to FAC1 after reception of a select discrete by means of the F/O ADC INST pushbutton switch.
- SGU3 operates like SGU1 when it is switched over to Captain's side or when in standby. It operates like SGU2 when it is switched over to First Officer's side.

(f)FCU inputs

The FCU sends two buses to the SGUs.

- SGU1 receives FCU bus No.1
- SGU2 receives FCU bus No.2
- SGU3 receives FCU bus No.1 or No.2 depending on whether it replaces SGU1 or SGU2.

(g)VOR inputs

SGU1 receives data from VOR1.

SGU2 receives data from VOR2.

SGU3 receives data from VOR1 or VOR2, depending on whether it replaces SGU1 or SGU2.

(h)ILS inputs

The three SGUs receive and use both ILS.

On Captain's side, ILS1 data is displayed on the PFD ; ILS2 data is displayed on the ND.

On First Officer's side, ILS2 data is displayed on the PFD ; ILS1 data is displayed on the ND.

(i)Radio altimeter inputs

Each SGU receives data from both radio altimeters.

SGU1 uses data from radio altimeter No.1 in normal operation. It automatically switches over to radio altimeter No.2 in case of No.1 failure.

SGU2 uses data from radio altimeter No.2 in normal operation. It automatically switches over to radio altimeter No.1 in case of No.2 failure.

SGU3 operates like SGU1 when it is in standby or when it replaces SGU1. It operates like SGU2 when it replaces it.

(j)ADF inputs

Each SGU receives data from both ADFs and uses them simultaneously.

The bearings are displayed on the ND in ROSE mode only.

(k)FWC input

Each SGU receives data from both FWC.

- SGU1 uses FWC1 in normal operation. It automatically switches over to FWC2 in case of failure of FWC1.
- SGU2 uses FWC2 in normal operation. It automatically switches over to FWC1 in case of failure of FWC2.
- SGU3 operates like SGU1 when it is in standby or when it replaces SGU1. It operates like SGU2 when it replaces it.

The SGUs use label 145 word on which a certain number of warning messages are transmitted and the CHECK ATT discrete.

Bits 11 to 16 are used by the EFIS :

. bit 14 (or 15) : L (or R) HDG FAULT

. bit 12 : CHECK HDG

This bit is set to 1 when a heading discrepancy is detected between sides 1 and 2.

In this case, HDG warning message is displayed on both NDs.

. bit 11 : CHECK ATT

This bit is set to 1 when a heading discrepancy is detected between sides 1 and 2.

. bit 14 : GLIDE DVN ALARM

This bit is set to 1 when the FWC detects too great a glide slope deviation. In this case, the glide slope deviation flashes on Captain's and First Officer's DUs.

. bit 13 : LOC DVN ALARM

This bit is set to 1 when too great a LOC deviation is detected by the FWC.

The LOC deviation then flashes on Captain's and First Officer's DUs.

. CHECK ATT discrete

This discrete grounds when an attitude discrepancy is detected between sides 1 and 2. The CHECK ATT warning message is then displayed on both PFDs.

(l)EFIS control panel inputs

SGU1 receives and processes data from Captain's control panel bus.

SGU2 receives and processes data from First Officer's control panel.

SGU3 receives data from both control panels : it processes Captain's control panel data when in standby or when it replaces SGU1. It processes First Officer's control panel data when it replaces SGU2.

A list of the words used is provided in tables 11 to 15. It includes :

- one discrete word (Label 272) which indicates the modes of operation (Ref. Table 12)
- one discrete word (Label 273) which indicates the value of flight path angle and map range (Ref. table 13)
- one BCD word (Label 170) which indicates the value of decision height (Ref. table 14)
- one word (Label 271) which indicates the weather radar range (Ref. table 15).

TABLE 11
BUS DEFINITION
LIST OF LABELS

LABEL	SDI	PARAMETER	UNITS	RANGE	BCD	BNR	SIG/BIT/S	RESOL	ACCURACY	UPDATE INTERV MEAN	UPDATE INTERV tol	USED
170		Selected Decision height	Feet	-5 to +2500	x		-	5	± 5	100	± 50	x
271		WR Range	N.M.	5.320	-	-	-	5	-	100	± 50	x
272		Discrete Word 1	-	-	-	-	-	-	-	100	± 50	x
273		Discrete Word 2 (Selected FPA)	-	-	-	-	-	-	-	100	± 50	x

TABLE 12
BUS DEFINITION
DISCRETE WORD 1 - LABEL 272 - LIST OF DISCRETES

LABEL/BIT	PARAMETER	FUNCTION	
		1	0
272 9	SDI		
10			
11	MAP MODE Select	REQUESTED	NOT REQUESTED
12	VOR MODE Select	REQUESTED	NOT REQUESTED
13	ILS MODE Select	REQUESTED	NOT REQUESTED
14	PLAN MODE Select	REQUESTED	NOT REQUESTED
15	DH SETTING	REQUESTED	NOT REQUESTED
16	FPA SETTING	REQUESTED	NOT REQUESTED
17	SUM CHECK	VALID	NOT VALID
18	SPARE	REQUESTED	NOT REQUESTED
19	VOR-D PUSHBUTTON 3	REQUESTED	NOT REQUESTED
20	CSTR PUSHBUTTON 1	REQUESTED	NOT REQUESTED
21	NDB PUSHBUTTON 4	REQUESTED	NOT REQUESTED
22	ARPT PUSHBUTTON 5	REQUESTED	NOT REQUESTED
23	WPT PUSHBUTTON 2	REQUESTED	NOT REQUESTED
24	MAP ORIENTATION DISC 2	TRACK UP	HEADING UP
25	VOR/ILS Mode 1	ILS	VOR or NAV
26	SPARE	RESET	NOT RESET
27	SPARE	REQUESTED	NOT REQUESTED
28	FULL ROSE	REQUESTED	NOT REQUESTED
29	TEST INITIATE	REQUESTED	NOT REQUESTED
30,31	SSM		
32	PARITY		

LABEL/BIT	PARAMETER	FUNCTION	
		1	0

TABLE 13
BUS DEFINITION
DISCRETE WORD 2 - LABEL 273 - LIST OF DISCRETES

LABEL/BIT	PARAMETER	FUNCTION	
		1	0
273 9	SDI		
10			
11	0.1	ENCODING :	
12	0.2	Binary Numbers shown indicate positive Numbers (BIT Sign 19 = 0) Negative Numbers shall be represented in 2's complement bit 18 included	
13	0.4		
14	0.8		
15	1.6		
16	3.2		
17	6.4		
18	-		
19	SIGN	NEGATIVE	POSITIVE
20	SPARE		
21	DISCRETE 3	VOR	NAV or ILS
22	TBD		
23	ARC MODE	REQUESTED	NOT REQUESTED
24	5	ENCODING	
25	10	SPECIAL CODE ARINC 708 320 NM = 000000	
26	20		
27	40	RANGE SELECTED NAUT MILES	
28	80		
29	160		

LABEL/BIT	PARAMETER	FUNCTION	
		1	0
30	SSM		
31			
32	PARITY		

TABLE 14
BUS DEFINITION
DISCRETE WORD 3 - LABEL 170 - DECISION HEIGHT SELECTED
LIST OF DISCRETES

LABEL/BIT	PARAMETER	FUNCTION	
		1	0
170 9			0
10			0
11			
14	PADS	Example : DH = 150 ft.	
15			0
16	BCD 4 : 0		0
17			0
18			0
19		1	
20			0
21	BCD 3 : 5	1	
22			0
23		1	
24	BCD 2 : 1		0
25			0
26			0
27			0
28	BCD 1 : 0		0
29			0
30			0
31			0
32	PARITY		

TABLE 15
BUS DEFINITION

WORD 4 - LABEL 271
WEATHER RADAR RANGE
LIST OF DISCRETES

LABEL/BIT	PARAMETER	FUNCTION	
		1	0
271 9	SDI		
10			
11			
23	TBD		
		EXAMPLE : RANGE 45 NM	
24	5 NM 5	1	
25	10 NM 0		0
26	20 NM Sigma = 45 0		0
27	40 NM 40	1	
28	80 NM 0		0
29	160 NM 0		0
30	VALID/SLAVE	30 31 / 0 0 VALID	30 31 / 1 0 N.O
31		0 1 INVALID	1 1 SLAVE
32	PARITY		

(2)Radar Inputs

(a)Interconnections

The three SGUs are connected to each of the two weather radars. They operate from weather radar No. 1 or 2 depending on which one is in operation. SGU switchover is automatic : if they no longer receive data from radar 1, they use radar 2 bus and conversely.

Each radar transceiver receives data from both EFIS control panels and transmits them to two output busses, one of which is directed to side 1 EFIS with range selected on side 1, the other to side 2 EFIS with range selected on side 2.

SGU3 thus receives four radar busses :

- two busses from weather radar No. 1. It uses either, depending on whether it is in position 1 or 2.
- two busses from weather radar No. 2. It uses either, depending on whether it is in position 1 or 2.

(b)Transmission description

The weather radar bus is a very high speed bus (10^6 bits per second) with a two-phase Manchester type modulation.

- The radar image is made up of a number of beams comprised between 512 and 1024 (512 for a $\pm 45^\circ$ antenna scanning ; 1024 for a $\pm 90^\circ$ scanning around aircraft heading.
  The maximum time of acquisition, therefore tracing of a complete image is 4 sec (for a $\pm 90^\circ$ scanning).
- Each radar word comprises 1600 bits and transmits all the echoes in a given radius.
  There are 512 echoes per beam, each echo is coded in 3 bits
  A word is composed as follows :
  - bits 1 thru 8 : label (055)
  - bits 9 and 10 : monitor bits
  - bits 20 thru 26 : bits coding the operation faults of the transceiver
  - bits 27 thru 29 : mode of operation
  - bits 30 thru 36 : tilt
  - bits 43 thru 48 : range
  - bits 50 thru 51 : monitor bits
  - bits 52 thru 63 : antenna position (angle of scanning)
  - bits 65 thru 1600 : 512 3-bit echoes

(3)FMC inputs

(a)Interconnections

SGU1 processes FMC1 data.
SGU2 processes FMC2 data.
SGU3 processes FMC1 data when it is switched over to side 1 or when in standby. It processes FMC2 data when it is switched over to side 2.
FMC1 operates in compliance with the modes and ranges displayed on Captain EFIS control panel.
FMC2 operates in compliance with the modes and ranges displayed on First Officer EFIS control panel.

(b)Transmission principle

FMC bus in an ARINC 429 high-speed bus which transmits two types of data :

- dynamic data such as ground speed, location etc.
- static or background data which serve for representing the various symbols of the flight plans.

These two types of data are received in separate overlapping blocks as shown in the following figure.

1 Dynamic data

This data is processed as normal ARINC 429 data : each parameter has its own label. The start of the data block is indicated by a specific control word (Start of Dynamic Data) having label 303.

2 Background data

The complete image is transmitted to the SGU every 3 seconds.
It can require up to 8 data blocks maximum.
The various blocks are identified by control words which indicate the block number.
The data is divided into various groups of words. Each group represents a type of symbol (ex : waypoint group, VOR station group etc...).
Within a group, all the words have the same label. Therefore the transmission order is most important, as the image outline follows this order.

(4)SGU analog inputs

Discrete inputs are applied to the SGU to select the various modes of operation.

There are two types of discretes :

- Open circuit-ground
  A ground which is internal to the SGU available on a program pin common.
- 28V open circuit.

An exhaustive list is provided in table 16.

These inputs are wired on the top insert of the connector.

The pins are different depending on whether SGU1 or SGU2 is considered, as SGU3 can be switched over to side 1 or side 2 and uses side 1 or side 2 inputs as a function of the reconfiguration status.

(a)Bus selection discrete inputs

- selection of IRS3
- selection of opposite ADC/FAC
- selection of TCC1 or TCC2
- selection of opposite FD
- selection of opposite FMC (option)
- selection of opposite VOR receiver (option)
- selection of opposite ILS receiver (option)

(b)Mode selection inputs

- Switchover from FD mode to FPV mode and conversely
- FD bars and flight path vector clearing
- Baro altitude or standard flight level
- Flight - Ground discrete
- PFD extinction

**ON A/C 001-100,

- PFD and ND image transfer
- SGU extinction

**ON A/C 101-200,

- SGU extinction

**ON A/C ALL

The SGU1 is switched off when PFD1 and ND1 are off
The SGU2 is switched off when PFD2 and ND2 are off
The SGU3 is switched off when PFD1 and 2 and ND1 and 2 are off.

- Ground tests

The SGUs select test procedures depending on the state of two test discretes.

Test 1	Test 2	Function
open	open	Image normal
ground	open	DU test
open	ground	Input test
ground	ground	BITE memory display

Test 1	Test 2	Function

(c)Programming inputs
- Source data identification (SGU1, 2 or 3)
All three SGUs being perfectly identical and interchangeable, these two discretes indicate to the SGU its position on the aircraft :

SDI code 2	SDI code 1	Position
open	open	-----
open	ground	1
ground	open	2
ground	ground	3

- SGU3 part

EFIS select.1	EFIS select.2	SGU3 part
open	open	Standby
28V	open	Replace SGU1
open	28V	Replace SGU2
28V	28V	------

R - ADF1 SUPPRESSION pin program
R open circuit = ADF1 installed
R ground circuit = ADF1 not installed
R - ADF2 SUPPRESSION pin program
R open circuit = ADF2 installed
R ground circuit = ADF2 not installed
R - ILS SWITCHING (option) pin program = ground circuit
R - FMC/IRS pin program
R open circuit = wind data from IRS
R ground circuit = wind data from FMC

(d)Inputs indicating DU status
- PFD failure
- ND failure
- PFD overtemperature
- ND overtemperature
- Loss of PFD red gun
- Loss of ND red gun

(e)Attitude comparison result
CHECK ATT alarm discrete (see para. 1(k)).

TABLE 16

List of SGU Analog Inputs

Parameter	SGU 1	SGU 3	SGU 2	Others	Type	Level	Origin
PFD A anomaly correct	E	E	-	PFD	Disc.	ground open	PFD L
PFD B anomaly correct	-	E	E	PFD	Disc.	ground open	PFD R
ND A anomaly correct	E	E	-	ND	Disc.	ground open	ND L
ND B anomaly correct	-	E	E	ND	Disc.	ground open	ND R
PFD A temperature correct	E	E	-	PFD	Disc.	ground open	PFD L
PFD B temperature correct	-	E	E	PFD	Disc.	ground open	PFD R
ND A temperature correct	E	E	-	ND	Disc.	ground open	ND L
ND B temperature correct	-	E	E	ND	Disc.	ground open	ND R
a ND selected up normal	E	E	-	-	Swit.	ground open	Switch 1 PFD/ND
b ND selected up normal	-	E	E	-	Swit.	ground open	Switch 2 PFD/ND
EFIS select 1	-	E	-	PFD & ND	Swit.	28V open	Switch 1 EFIS SGU
EFIS select 2	-	E	-	PFD & ND	Swit.	28V open	Switch 2 EFIS SGU
a ADC/FACR select ADC/FACL select	E	E	-	-	Swit.	ground open	Switch 1 ADC INST
b ADC/FACL select ADC/FACR select	-	E	E	-	Swit.	ground open	Switch 2 ADC INST
a IRS C selected IRS L selected	E	E	-	-	Swit.	ground open	Switch 1 ATT HDG
b IRS C selected	-	E	E	-	Swit.	ground	Switch 2

Parameter	SGU 1	SGU 3	SGU 2	Others	Type	Level	Origin
IRS R selected						open	ATT HDG
a FMC selected	E	E	-	-	Swit.	ground open	Switch 1 FMC-option
b FMC selected	-	E	E	-	Swit.	ground open	Switch 2 FMC-option
ADF Index 1 Index 2	E	E	E	-	Disc.	ground open	ADF control unit (1ADF)
L TCC selected	E	E	E	-	Swit.	28 V open	TCC1
R TCC selected	E	E	E	-	Swit.	28 V open	TCC2
a FPV/FD switching	E	E	-	-	Swit.	ground open	Add panel 1
b FPV/FD switching	-	E	E	-	Swit.	ground open	Add panel 2
CAPT FD	E	E	-	-	Swit.	28 V open	Switch 1 FD
F/O FD	-	E	E	-	Swit.	28 V open	Switch 2 FD
L FPV and FD off	E	E	-	-	Swit.	ground open	Add panel 1
R FPV and FD off	-	E	E	-	Swit.	ground open	Add panel 2
Flight/Ground	E	E	E	-	Disc.	ground open	A/C signal
DH + H alert	E	E	E	-	P.Pin	ground open	-
H alert 1	E	E	E	-	P.Pin	ground open	-
Check ATT	E	E	E	-	Disc.	ground open	FWC
FMC IRS	E	E	E	-	P.Pin	ground open	-

	Parameter	SGU 1	SGU 3	SGU 2	Others	Type	Level	Origin
R	PP SUPPR ADF1	E	E	E	-	P.Pin	ground	-
R							open	
R	PP SUPPR ADF2	E	E	E	-	P.Pin	ground	-
R							open	
	PP PWS	E	E	E	-	P.Pin	ground	A/C signal
							open	
	Switch PWS AUTO/OFF	E	E	E	-	P.Pin	ground	A/C signal
							open	
	SDI code 2	E	E	E	-	P.Pin	ground	-
							open	
	SDI code 1	E	E	E	-	P.Pin	ground	-
							open	
	ILS switch	E	E	E	-	P.Pin	ground	-
							open	
	a ILS select	E	E	-	-	Swit.	ground	switch 1
							open	ILS-option
	b ILS select	-	E	E	-	Swit.	ground	switch 2
							open	ILS-option
	a FL Standard Alt	E	E		-	Disc.	ground	Alti. 1
							open	
	b FL Standard Alt		E	E	-	Disc.	ground	Alti. 2
							open	
	L PFD off	E	E		-	Disc.	28V	Add panel
							open	1
	R PFD off		E	E	-	Disc.	28V	Add panel
							open	2
	Test 1	E	E	E	-	Disc.	ground	Test panel
							open	
	Test 2	E	E	E	-	Disc.	ground	Test panel
							open	
	SG power down on	E	E	E	-	Swit.	ground	Switch
							open	
	PFD A beam anom normal	E	E		-	-	ground	PFD L
							open	

Parameter	SGU 1	SGU 3	SGU 2	Others	Type	Level	Origin
PFD B beam anom normal		E	E	-	-	ground open	PFD R
ND A beam anom normal	E	E		-	-	ground open	ND L
ND B beam anom normal		E	E	-	-	ground open	ND R
a VOR select	E	E		-	-	ground open	switch 1 VOR-option
b VOR select		E	E	-	-	ground open	switch 2 VOR-option

(5)SGU output signals

(a)Outputs towards the DUs

The SGUs control the DUs through eight different control signals. Therefore each SGU comprises 8 outputs towards the PFD and 8 outputs towards the ND. Each output uses a twisted shielded cable.
The cable shield enters the SGUs, in which the grounding is performed.
These signals comprise :

- 5 color control signals
- 1 raster or stroke shading control signal
- 1 vertical deviation signal
- 1 horizontal deviation signal

SGU3 has only one series of outputs towards the PFD (or ND). The distribution towards PFD1 or 2 (or ND1 or 2) is done through terminal strips.

(b)ARINC 429 bus output

This low-speed bus transmits binary words and discrete words (Ref. Table 17).

1 Binary words

The SGUs output a certain number of labels read on the input sensors : the value received is retransmitted. The SSM matrix is set to FAIL in case of failure of the parameter, to normal operation otherwise. The SDI is the same as the SGU except for roll and pitch for which the SDI recopies the number of the IRS used. The SGU outputs the roll and pitch values computed from displayed vectors (labels 130 and 131).

TABLE 17
MAINTENANCE MONITORING DIGITAL OUTPUTS

FUNCTION	OCTAL LABEL	SIGNAL FORMAT	BIT RATE	SIGNIFICANT BITS/ FIGURES	RANGE	APPROX RESOLUTION	UPDATE RATE	UNITS
G/S DEV	170	BNR	LOW	10	± 0.8	000	10	DDM
GRND SPD	312	BNR	LOW	.	0.2048	1.0	5	KTS
LOC DEV	173	BNR	LOW	10	± 0.4	0004	10	DDM
MAG HDG	320	BNR	LOW	10	± 180	2	10	DEG
PITCH ANGLE	324	BNR	LOW	10	± 180	2	20	DEG
RADIO ALT	164	BNR	LOW	11	± 8192	2	10	FT
ROLL ANGLE	325	BNR	LOW	10	± 180	2	20	DEG
TRK ANGLE MAG	317	BNR	LOW	10	± 180	2	10	DEG
TRK ANGLE TRUE	313	BNR	LOW	10	± 180	2	10	DEG
TRUE HDG	314	BNR	LOW	10	± 180	2	10	DEG
DISCRETES 1	350	DIS	LOW	19	N/A	N/A	5	N/A
DISCRETES 2	270	DIS	LOW	19	N/A	N/A	5	N/A
DISCRETE 3	271	DIS	LOW	19	N/A	N/A	5	N/A
DECISION HEIGHT	370	BNR	LOW	19	8192	0.1	5	FT
COMP. AIRSPEED	206	BNR	LOW	14	1024	0.0625	5	KT
ALTITUDE	203	BNR	LOW	17	131072	1	5	FT
ANGLE OF ATTACK	221	BNR	LOW	12	180	0.05	5	DEG
MACH	205	BNR	LOW	13	4096	0.5	5	nbM
TAT	211	BNR	LOW	11	512	0.5	5	OC
VMO	207	BNR	LOW	12	1024	0.25	5	KT
SGU PITCH DISPLAY	130	BNR	LOW	10	± 180°	0.2	20	DEG
SGU ROLL DISPLAY	131	BNR	LOW	10	± 180°	0.2	20	DEG

2 Discrete words (Table 18)
- Validity discretes (label 350)
  . The bits are set to 1 when a failure in the corresponding equipment has been confirmed, that is when one of the labels used is failed or absent for a period which is a function of the parameter.
  . PFD fault and ND fault bits do not concern the picture but only the DU :
  for example, L PFD fault bit is set to 1 in case of failure of the LH upper DU and remains on 1 even if a PFD/ND transfer is performed.
  In this case, L ND fault bit remains on 0.
  . ILS1 (or 2) fault bits are set to 1 in case of glide, LOC or runway heading loss, whatever the position of VOR/NAV/ILS switch.
  . RA fault bit is set to 1 in case of loss of radio height, irrespective of ground altitude and slat position.

TABLE 18

MAINTENANCE MONITOR

R DISCRETES 1 (OCTAL LABEL 350)

**ON A/C ALL

Bit No.	CONDITION
11	L PFD FAULT
12	R PFD FAULT
13	SPARE
14	L CP FAULT
15	R CP FAULT
16	L ND FAULT
17	R ND FAULT
18	SG FAULT
19	SPARE
20	
21	
22	ILS 1 fault
23	ILS 2 fault
24	SPARE
25	SPARE
26	SPARE
27	SPARE
28	RA 1 fault
29	RA 2 fault

DISCRETES 2 (OCTAL LABEL 270)

Bit No.	CONDITION
11	INNER MARKER
12	MIDDLE MARKER
13	OUTER MARKER
14	DH ALERT
15	DH Δ H ALERT
16	H ALERT
17	SPARE
18	
19	WXR mode (bit 27 label 055 WXR)
20	WXR mode (bit 28 label 055 WXR)
21	WXR mode (bit 29 label 055 WXR)
22	MANTHR
23	ATHR MODE
24	
25	
26	

Bit No.	CONDITION

Bit No.	CONDITION
27	
28	
29	

**ON A/C ALL

DISCRETE 3 (OCTAL LABEL 271)

Bit No.					
9		0	1	0	
10	SDI	0 : SGU1	0 : SGU2	1 : SGU3	
11	Spare				
12		0	1	0	
13	FD used	1 : FD1	0 : FD2	0 : none	
14		0	1	0	
15	IRS Used	0 : IRS1	0 : IRS2	1 : IRS3	
16	ADC used	(0 : ADC1	1 : ADC2)		
17	FCC used	(0 : FCC1	1 : FCC2)		
18	RA used	(0 : RA1	1 : RA2)		
19	TCC used	(0 : TCC1	1 : TCC2)		
20	Spare				
24	MODE		(0)	(1)	(0)
25	MODE		(0)= NAV ;	(0)= ILS ;	(1)= VOR
26	ROSE MODE	(1 = ROSE	0 = ROSE)		
27	0 Rose	(1)	(0)	(1)	
28	0 or Test	(0) = Map	(1)= Plan	(1) = ARC	
29	Test Mode	(1 = test ;	0 = test)		

- Warning discretes (label 270)
  Reserved.
- Configuration discretes (label 271)
  . SDI bits (9 and 10) encode SGU position.
  (SDI = 3 for the SGU, whatever its position)
  . bits 12 and 13 encode the number of the FD used for bar display ((0.0) in FPV or OFF mode).
  . bit 17 encodes the number of the FCC used for FMA display.

(c)Analog outputs (Ref. Table 19)

1 Attitude validity

This is a 28V output when the attitude data is displayed on either DU. It changes to 0 when ATT warning message is present or PFD image is

not displayed.
It is 28V when PFD image is displayed on the lower DU or if CHECK ATT message is displayed.

2 FD validity
This is a 28V output as long as the FD bars can be displayed, that is as long as the corresponding labels are received with a correct SSM matrix.
It changes to 0 in the opposite case.

3 SGU validity
This output grounds in case of SGU failure or loss of power supply.

4 Radar request
This output grounds in MAP mode

5 Bar removal
This output grounds in FPV or OFF mode.

6 BITE load
This output grounds when the contents of the BITE memory related to the active flight differs from zero.

TABLE 19

List of SGU Analog Outputs

Parameter	SGU 1	SGU 3	SGU 2	Others	Type	Level	Origin
DH alert					Disc.	ground open	-
DH + H alert					Disc.	ground open	-
H alert					Disc.	ground open	-
Altitude valid Anomaly	S	S	S		Disc.	28V open	FCC
FD valid Anomaly	S	S	S		Disc.	28V open	FCC
SG valid failure	S	S	S		Disc.	ground open	FWC
WR request	S	S	S		Disc.	ground open	WR control unit
L bars removal	S	S			Disc.	ground open	FCC
P bars removal		S	S		Disc.	ground open	FCC
Bite Load	S	S	S		Disc.	ground	Test panel

Parameter	SGU 1	SGU 3	SGU 2	Others	Type	Level	Origin
						open	

C. Display Unit Interface

(1)Input signals

(a)DU control

Each DU receives a series of 8 cables from the SGU by which it is driven in normal operation and a series of 8 connections for operation with SGU3.

It uses either group of inputs depending on the state of ALTERNATE SG SELECT discrete.

Open circuit = normal operation

28V = operation on SGU3.

The cable shield enters each DU and separates the normal inputs from SGU3 inputs and the deflection signals from the color signals.

(b)Manual brightness control

Each DU supplies adjustment potentiometers with a control voltage and receives two brightness control signals

- stroke brightness
- raster brightness

In the case of the PFD, one potentiometer serves for adjustment of these two types of brightness, and both inputs are connected to each other.

(c)DU extinction

An input signal from a switch installed on the shaft of the stroke brightness adjustment potentiometer enables complete extinction of the image

Open circuit : DU on

28V : DU off

(d)Automatic brightness control

Each DU is provided with brightness sensors located on its face. The signal is combined with the potentiometer signals to adjust the brightness with respect to the average value selected.

(2)Output signals

Each DU transmits to the SGU three analog signals concerning its state

- DU anomaly
  This output is in open circuit in normal operation. It grounds in the case of DU failure.
- DU beam
  This output is in open circuit in normal operation. It grounds in case of red gun loss.
- DU temperature
  This output is in open circuit in normal operation. It grounds in case of DU overtemperature.

D. Control Panel Interface

(1)Input signals

(a)Brightness intensity

When this input is not connected, the brightness of the pushbutton switch lights is maximum (Day position).

When it is grounded, a medium brigthness is obtained (Night position).

(b)Test of lights and display windows

When this input grounds, all pushbutton switch lights come on and 888 is displayed.

(c)Programming discretes

Three programming input signals are available. The corresponding mode is encoded in the control unit output bus. Only two signals are used :

- **VOR/NAV/ILS** mode

These inputs are connected to **VOR/NAV/ILS** switch located on the complementary control panel.

	T	V
VOR	Ground	Open Circuit
NAV	Ground	Ground
ILS	Open Circuit	Ground

Then this data is encoded in output in word 272, bit 25 and in Word 273, bit 21.

(2)Output signals

The values displayed on the control unit and the position of the various selector switches are encoded in **ARINC** 429 low-speed output bus.

4 labels are used : 272, 273, 271 and 170.

(Ref. Tables 11 thru 15).

R

1. Operational Test

A. EFIS/DISPLAYS Test

(1)Reason for the job

To check generation of a test pattern by SGU1, 2 and 3 on the PFD and ND.

(2)Equipment and Material

ITEM	DESIGNATION
Referenced Procedures	
- 24-41-00, P. Block 301	AC External Power Control
- 34-25-00, P. Block 501	Inertial Reference System
- 32-00-00, P. Block 501	Landing Gear

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers particularly those associated with NAVIGATION.
- Close L/G PROX DET & RELAYS SYS1/FLT/GND and RELAYS & RETRACT CTL circuit breakers on panel 133VU (Aircraft in ground configuration).

**ON A/C 001-100,

- On L and R instrument panels make certain that EFIS-SGU and PFD/ND XFR pushbutton switches legends are off.

**ON A/C 101-200,

- On L and R instrument panels make certain that EFIS-SGU pushbutton switch legends are off.

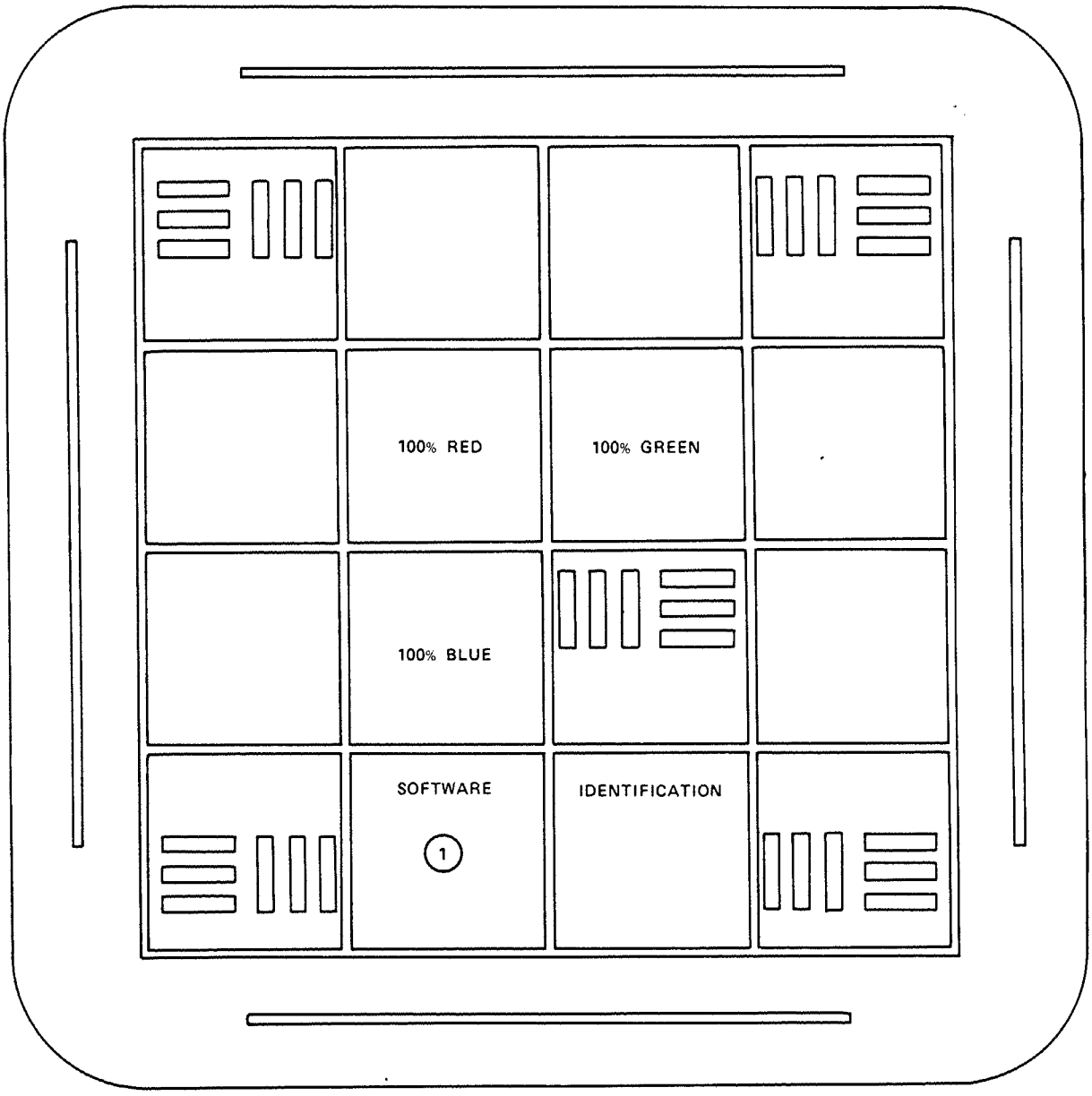
**ON A/C ALL

- Make certain that EFIS is operating and adjust PFD and ND image brightness on panels 412VU and 413VU.
- Take safety measures prior to opening circuit breakers 119 GB and 2GB (Ref. 32-00-00, P. Block 501).

(b)Test

(Ref. Fig. 501)

NOTE : The test described below concerns CAPT EFIS ; for F/O EFIS test which is identical, refer to information in



1 "EXX" ON PFD/ND DISPLAY UNITS

BM5 34 /1 00 5 AWMU-16-14
DM5

EFIS - Test Pattern
Figure 501

parenthesis.

ACTION	RESULT
1. On maintenance panel 47OVU - press EFIS/ECAM DISPLAYS pushbutton switch	Check that - TEST legend comes on - Test pattern appears on all display units after 2 or 3 s. NOTE : The test pattern must appear simultaneously on the 6 display units (4 EFIS, 2 ECAM). - SGU software identification appears on the lower part of all display units.
2. On circuit breakers panel 133VU open then close L/G PROX DET & RELAY/SYS1 FLT/GND circuit breaker 119GB - U/52 and L/G PROX DET & RELAYS SYS1/RELAYS & RETRACT CTL circuit breaker 2GB - U/51	- On CAPT and F/O display units, test pattern goes off then reappears. - On maintenance panel 47OVU, TEST legend stays on NOTE : Leave circuit breakers open until normal display reappears then close circuit breakers. Test pattern will then return.
3. On L (R) instrument panel 402VU (406VU) - press EFIS/SGU pushbutton switch	- SYS3 legend comes on - On CAPT (F/O) PFD and ND test pattern stays on
- on circuit breakers panel 133VU open then close L/G PROX DET & RELAY/SYS 1 FLT/GND circuit breaker 119GB - U/52 and L/G PROX DET & RELAYS SYS1/RELAYS & RETRACT CTL circuit breaker 2GB - U/51	- On CAPT (F/O) PFD and ND test pattern goes off then reappears - On maintenance panel 47OVU, TEST legend stays on. NOTE : Leave circuit breakers open until normal display reappears then close circuit breakers. Test pattern will then return.
- release EFIS/SGU pushbutton switch	- SYS3 legend goes off
4. Release DISPLAYS pushbutton switch	- TEST legend goes off - patterns previously displayed on all display units disappear

(c)Close-up

1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

2 Restore system and aircraft to normal operating condition.

B. EFIS/INPUTS Test

**ON A/C 001-100,

(Ref. Fig. 502)

**ON A/C 101-200,

R (Ref. Fig. 503)

**ON A/C ALL

(1)Reason for the job
To check all the ARINC 429 bus inputs on SGU1, 2 and 3.
(2)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure	
- 24-41-00, P. Block 301	AC External Power Control
- 34-25-00, P. Block 501	Inertial Reference System

(3)Procedure
WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.
(a)Job set-up
- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION and ECAM.
- Align the IRS (Ref. 34-25-00, P. Block 501).
- Make certain that FMS is operating.
NOTE : The IRS must be fully aligned before starting the test.
- Place PITCH TRIM 1 lever in ON position.
- Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (Aircraft in ground configuration).

**ON A/C 001-100,

- On L and R instrument panels make certain that EFIS-SGU and PFD/ND XFR pushbutton switches legends are off.

**ON A/C 101-200,

- On L and R instrument panels make certain that EFIS-SGU pushbutton switch legends are off.
- Make certain that EFIS is operating and adjust PFD and ND image brightness on panels 412VU and 413VU.
NOTE : If an input sensor is failed (or not installed) the

IN CASE OF NORMAL OPERATION

```
INPUTS TEST
                    For SGU 3
                    Select SYS 3

— SGUn BUS INPUT NORM
```

THIS MESSAGE DISAPPEARS WHEN SGU 3 IS SELECTED.

IN CASE OF FAULT

```
INPUTS TEST
                    For SGU 3
                    Select SYS 3

— SGUn BUS INPUT FAULT

IRS  1          IRS 3          IRS  2
ADC  1                         ADC  2
FCC  1                         FCC  2
FAC  1                         FAC  2
TCC  1                         TCC  2
FCU  1                         FCU  2
FMC  1                         FMC  2
ILS  1                         ILS  2
VOR  1                         VOR  2
ADF  1                         ADF  2
FWC  1                         FWC  2
LRRA 1                         LRRA 2
CTL PNL 1                      CTL PNL 2
```

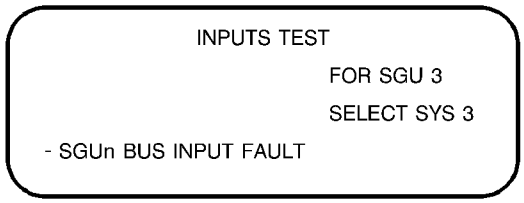
n INDICATES WHICH SGU GENERATES THE IMAGE.

FOR CAPT PFD:n=1 OR 3
FOR F/O PFD:n=2 OR 3

BM5 34 71 00 5 AXM0 18 14
DM5

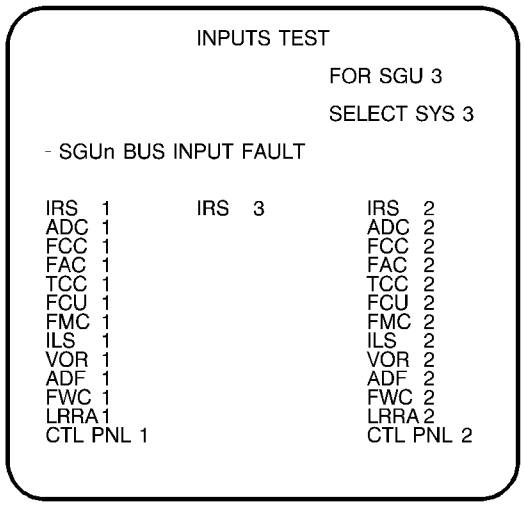
Test of EFIS SGU Inputs
Figure 502

IN CASE OF NORMAL OPERATION



THIS MESSAGE DISAPPEARS WHEN SGU 3 IS SELECTED.

IN CASE OF FAULT



n INDICATES WHICH SGU GENERATES THE IMAGE.

FOR CAPT PFD= 1 OR 3
FOR F/O PFD= 2 OR 3

NOTE: SGU BUS INPUT FAULT AND TCC 2 FAULT WILL ALWAYS BE DISPLAYED DUE TO THE ABSENCE OF NUMBER TWO THRUST CONTROL COMPUTER, TCC2.

BM5 34 71 00 5 AXN0 03

Test of EFIS SGU Inputs
Figure 503

corresponding message will be displayed.
NOTE : SGU BUS INPUT FAULT and TCC2 FAULT indications will always be displayed on PFD due to absence of TCC2.

(b)Test

ACTION	RESULT
1. On maintenance panel 47OVU - press EFIS/INPUTS pushbutton switch	Check that - TEST legend comes on - On CAPT PFD the following text is displayed INPUTS TEST FOR SGU3 SELECT SYS3 SGU1 BUS INPUT FAULT - On F/O PFD the following text is displayed INPUTS TEST FOR SGU3 SELECT SYS3 SGU2 BUS INPUT FAULT

R **ON A/C 001-100,

R - Make certain that EFIS is operating and adjust PFD and ND image
R brightness on panels 412VU and 413VU.
R NOTE : If an input sensor is failed (or not installed) the
R corresponding message will be displayed.
R (b)Test

R ACTION	RESULT
R 1. On maintenance panel 47OVU R - press EFIS/INPUTS pushbutton switch	Check that R - TEST legend comes on R - On CAPT PFD the following text is displayed R INPUTS TEST FOR SGU3 R SELECT SYS3 R SGU1 BUS INPUT NORM R - On F/O PFD the following text is displayed R INPUTS TEST FOR SGU3 R SELECT SYS3 R SGU2 BUS INPUT NORM

R **ON A/C ALL

2. On L instrument panel 402VU

R **ON A/C 101-200,

- press EFIS/SGU pushbutton switch	- SYS3 legend comes on - On CAPT PFD the following text is

ACTION	RESULT
	displayed INPUTS TEST SGU3 BUS INPUT FAULT
- release EFIS/SGU pushbutton switch	- SYS3 legend goes off
3. Release EFIS/INPUTS pushbutton switch	- TEST legend goes off - On all display units the previous texts disappear.
**ON A/C 001-100,	
- press EFIS/SGU pushbutton switch	- SYS3 legend comes on - On CAPT PFD the following text is displayed INPUTS TEST SGU3 BUS INPUT NORM
- release EFIS/SGU pushbutton switch	- SYS3 legend goes off
3. Release EFIS/INPUTS pushbutton switch	- TEST legend goes off - On all display units the previous texts disappear.
**ON A/C ALL	

(c)Close-up
1 Disengage PITCH TRIM 1 lever.
2 Place IRS and FMS switch in OFF position.
3 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
4 Restore system and aircraft to normal operating condition.

C. EFIS/BITE test

(1)Reason for the job

Display of SGU's bite memories.

(2)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION.
- Close L/G PROX DET & RELAYS circuit breakers on panel 133VU (Aircraft in ground configuration).

R **ON A/C 001-100,

- On L and R instrument panels make certain that EFIS-SGU and PFD/ND XFR pushbutton switches legends are off.

R **ON A/C 101-200,

- On L and R instrument panels make certain that EFIS-SGU pushbutton switch legends are off.
- Make certain that EFIS is operating and adjust PFD and ND image brightness on panels 412VU and 413VU.

NOTE : LOAD legend on EFIS/BITE pushbutton switch is normally off ; if not see TSM (Troubleshooting Manual), EFIS BITE procedure.

NOTE : SGU BUS INPUT FAULT and TCC2 FAULT indications will always be displayed due to absence of TCC2.

(b)Test

ACTION	RESULT
1. On maintenance panel 470VU - press EFIS/BITE pushbutton switch	Check that - DSPL legend comes on - On CAPT PFD the following text is displayed BITE DSPL FOR SGU3 SELECT SYS3 LAST FLIGHT LEG - PFD1 NORM - ND1 NORM - SGU1 NORM - BUS INPUT FAULT - On CAPT ND the following text is displayed DSPL SGU1 BUS - On F/O PFD the following text is displayed BITE DSPL FOR SGU3 SELECT SYS3 LAST FLIGHT LEG - PFD2 NORM - ND2 NORM - SGU2 NORM - BUS INPUT FAULT - On F/O ND the following text is displayed DSPL SGU2 BUS

R **ON A/C 001-100,

R - Make certain that EFIS is operating and adjust PFD and ND image
R brightness on panels 412VU and 413VU.
R NOTE : LOAD legend on EFIS/BITE pushbutton switch is normally off ;
R if not, see TSM (Troubleshooting Manual), EFIS BITE procedure.

R (b)Test

R ACTION	RESULT
R 1. On maintenance panel 470VU R - press EFIS/BITE pushbutton switch	Check that - DSPL legend comes on - On CAPT PFD the following text is displayed BITE DSPL FOR SGU3 SELECT SYS3 LAST FLIGHT LEG - PFD1 NORM - SGU1 NORM - BUS INPUT NORM - On CAPT ND the following text is displayed DSPL SGU1 BUS - On F/O PFD the following text is displayed BITE DSPL FOR SGU3 SELECT SYS3 LAST FLIGHT LEG - PFD2 NORM - ND2 NORM - SGU2 NORM - BUS INPUT NORM - On F/O ND the following text is displayed DSPL SGU2 BUS
R **ON A/C ALL	
2. On L instrument panel 402VU	
R **ON A/C 101-200,	
- press EFIS/SGU pushbutton switch	- SYS3 legend comes on - On CAPT PFD the following text is displayed BITE DSPL LAST FLIGHT LEG - PFD1 NORM - PFD2 NORM - ND1 NORM - ND2 NORM - SGU3 NORM - BUS INPUT FAULT - On CAPT ND the following text is displayed DSPL SGU3 BUS
- release EFIS/SGU pushbutton switch	- SYS3 legend goes off

ACTION	RESULT
3. Release EFIS/BITE pushbutton switch	- DSPL legend goes off - On all display units the previous texts disappear.
**ON A/C 001-100,	
- press EFIS/SGU pushbutton switch	- SYS3 legend comes on - On CAPT PFD the following text is displayed BITE DSPL LAST FLIGHT LEG - PFD1 NORM - PFD2 NORM - ND1 NORM - ND2 NORM - SGU3 NORM - BUS INPUT NORM - On CAPT ND the following text is displayed DSPL SGU3 BUS
- release EFIS/SGU pushbutton switch	- SYS3 legend goes off
3. Release EFIS/BITE pushbutton switch	- DSPL legend goes off - On all display units the previous texts disappear.
**ON A/C ALL	

(c)Close-up
1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Restore system and aircraft to normal operating conditions.

D. EFIS Control Panel Test

NOTE : The EFIS CTL PNL controls associated with FMS and weather radar are checked in :
- 34-60-00, P. Block 501 - Position computing
- 34-41-00, P. Block 501 - Weather radar

(1)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure	
- 24-41-00, P. Block 301	AC External Power Control
- 34-25-00, P. Block 501	Inertial Reference System

(2)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION.
- Make certain that AP is not in CMD.

R **ON A/C 001-100,

- On L and R instrument panels make certain that EFIS-SGU and PFD/ND XFR pushbutton switches legends are off.

R **ON A/C 101-200,

- On L and R instrument panels make certain that EFIS-SGU pushbutton switch legends are off.

R **ON A/C ALL

- Make certain that EFIS is operating and adjust PFD and ND image brightness on panels 412VU and 413VU.
- Place VOR/NAV/ILS switch in other position than NAV
- Make certain that IRS1 & 2 are operating (on overhead panel, place MSU1 & 2 mode selector switch in NAV or ATT position) (Ref. 34-25-00, P. Block 501).

(b)Test

NOTE : The test described below concerns CAPT EFIS CTL PNL test ; for F/O EFIS CTL PNL test, which is identical, refer to information in parenthesis.

ACTION	RESULT
1. On overhead panel 436VU - place ANN LT switch in TEST posi-	Check that - lower strips of pushbutton switches

ACTION	RESULT
tion, then in **BRT** position	come on then go off on **EFIS** control panels
2. On **CAPT (F/O) EFIS** control panel - press **DH** pushbutton switch	- lower strip comes on - **DH** value is displayed
- display decision height of 130 ft. by means of **SET** knob	- On **CAPT (F/O) PFD DH** 130 ft. is displayed in bottom **R** corner
- press **FPA** pushbutton switch	- **DH** lower strip goes off - **FPA** lower strip comes on - on **CAPT (F/O) PFD, DH** information remains displayed.
3. On glareshield, panel **413VU (412VU)** - place selector switch in **FPV** position (It could be necessary to rotate **CRS** selector knob on **VOR/DME** control unit or **ILS** control box to center the target on **PFD**).	- Flight Path Target symbol appears on **CAPT (F/O) PFD**
4. On **CAPT (F/O) EFIS** control panel - display glide of -3.5 degrees by means of **SET** knob	- This value is displayed on **CAPT (F/O) EFIS CTL PNL** - Flight path target moves on **CAPT (F/O) PFD**
- press again **FPA** pushbutton switch	- lower strip goes off - **FPA** value disappears on **CAPT (F/O) EFIS CTL PNL** - Flight Path Target symbol disappears on **CAPT (F/O) PFD**
5. Place mode selector switch successively in **ROSE** **ARC** **MAP** and **PLAN** positions	On **CAPT (F/O) ND** check that **ROSE** mode image appears **ARC** mode image appears **MAP** mode image appears **PLAN** mode image appears

(c)Close-up
1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Restore system and aircraft to normal operating condition.

E. Complementary Navigation Control Panel Test

(1)Reason for the job

To check the brightness controls of the display units and mode selector switches (FPV/FD & VOR/NAV/ILS switches).

(2)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particularly those associated with NAVIGATION.

R **ON A/C 001-100,

- On L and R instrument panels make certain that EFIS/SGU, ATT/HDG, PFD/ND XFR pushbutton switches legends are off.

R **ON A/C 101-200,

- On L and R instrument panels make certain that EFIS/SGU and ATT/HDG pushbutton switches legends are off.

R **ON A/C ALL

- Make certain that EFIS are in OFF position (PFD and ND brightness knobs in OFF position)
- Make certain that IRS 1 & 2 are operating (on overhead panel place MSU 1 & 2 mode selector switch in NAV or ATT position)
- Place PITCH TRIM 1 lever in on position.
- On Captain and First Officer EFIS control panels, place mode selector switch in ROSE position.

(b)Test

NOTE : The test described below concerns CAPT EFIS; for F/O EFIS test which is identical, refer to information in paranthesis.

1 PFD brightness

ACTION	RESULT
1. On glareshield, panel 413VU (412VU) - Turn PFD knob to mid position	Check that - On CAPT (F/O) main instrument panel PFD comes on and PFD image is displayed
2. On the face of PFD cover the photocells	- The brightness dims.
3. Turn PFD knob from OFF to BRT	- PFD goes off then comes on again progressively
4. Uncover the photocells - Turn PFD knob to mid position	- Brightness returns to initial value

2 ND brightness

ACTION	RESULT
1. On glareshield, panel 413VU (412VU) - Turn inner ND knob to mid position	Check that - On CAPT (F/O) main instrument panel ND comes on and ND image in rose mode is displayed.
2. On face of ND cover the photocells	- The brightness dims.
3. On panel 413VU (412VU) - Turn the inner ND knob from OFF to BRT - Turn PFD knob to OFF position and outer ND knob to mid position - Turn outer ND knob from BRT to OFF	- ND goes off then comes on again progressively. - On CAPT (F/O) PFD image goes off - On CAPT (F/O) ND, PFD image appears in place of ND image in rose mode. - On CAPT (F/O) ND the brightness of the earth and sky increase then decrease.
4. Uncover the photocells - Turn PFD knob to mid position - Turn the inner and outer ND knobs to mid position.	- On CAPT (F/O) ND, image returns to initial value.

3 Not applicable

4 FPV/FD switching

ACTION	RESULT
On glareshield, panel 413VU (412VU)	Check that
1. - Turn PFD knob to mid position	- CAPT (F/O) PFD comes on
2. - place FPV/FD switch in ON position	- On CAPT (F/O) PFD, FD bars appear with V/S - HDG indicating FD basic mode
3. - push FPV/FD switch up twice	- On CAPT (F/O) PFD, flight path target appears then FD bars re-appear.

NOTE : It might be necessary to rotate the ILS CRS or VOR CRS selector switch according to the VOR, to the VOR/NAV/ILS switch position which could be in VOR or ILS position to get the target in view i.e., CRS selected should be A/C present HDG ± 020°.

5 VOR/NAV/ILS switching

ACTION	RESULT
On glareshield, panel 413VU (412VU)	Check that
1. - Turn ND knob to mid position	- CAPT (F/O) ND comes on
2. - place VOR/NAV/ILS switch in VOR position	On CAPT (F/O) ND - VOR symbol appears - lateral deviation scale is displayed in ROSE and ARC modes only
3. - place VOR/NAV/ILS switch in NAV position	- VOR symbol disappears - No deviation scale is displayed
4. - place VOR/NAV/ILS switch in ILS position	- ILS symbol appears - lateral and vertical deviation scales are displayed in ROSE and ARC modes only.

(c)Close-up

1 Disengage PITCH TRIM 1 system.

2 Switch off IRS 1 & 2

3 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).

4 Restore system and aircraft to normal operating condition.

F. Switching Test
(1)Reason for the job

R **ON A/C 001-100,

To check EFIS-SGU switching and PFD/ND XFR.

R **ON A/C 101-200,

To check EFIS-SGU switching.

R **ON A/C ALL

(2)Equipment and materials

ITEM	DESIGNATION
Referenced Procedure - 24-41-00, P. Block 301	AC External Power Control

(3)Procedure

WARNING : BEFORE POWER IS SUPPLIED TO THE AIRCRAFT MAKE CERTAIN THAT ELECTRICAL CIRCUITS UPON WHICH WORK IS IN PROGRESS ARE ISOLATED.

(a)Job set-up

- Energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
- Make certain that electronics racks ventilation is correct.
- Close overhead panel circuit breakers, particulary those associated with NAVIGATION and ECAM.

R **ON A/C 001-100,

- On L and R instrument panels make certain that EFIS-SGU and PFD/ND XFR pushbutton switches legends are off.

R **ON A/C 101-200,

- On L and R instrument panels make certain that EFIS-SGU pushbutton switch legends are off.

R **ON A/C ALL

- Make certain that EFIS is operating and adjust PFD and ND image brightness on panels 412VU and 413VU.
- On center pedestal adjust left ECAM display unit brightness.
- On ECAM control panel, press CLR pushbutton switch until MASTER WARN and MASTER CAUTION lights on panels 3VU and 5VU, go off and MEMO page is displayed on left ECAM display unit.

(b)EFIS SGU switching test

ACTION	RESULT
1. On overhead panel 436VU - place ANN LT switch in TEST position, then in BRT	Check that - on 402VU and 406VU all legends come on then go off

ACTION	RESULT
2. On panel 133VU - open circuit breaker 1GB (331/V52) L/G PROX DET & RELAYS SYS 2/FLT/ GND - open circuit breaker 2GB (332/U51) L/G PROX DET & RELAYS SYS 1/RELAYS & RETRACT CTL and wait for 3 minutes.	
3. On circuit breaker panel 21VU - open NAVIGATION EFIS/SGU3 circuit breaker 30FN3 (line 104-F/6) (On ECAM CTL panel, press CLR pushbutton switch, if necessary to have NAV ADC warning displayed)	- on left ECAM display unit the following text appears NAV ADC EFIS SGU 3 FAULT - EFIS ON SYS 3 ..... DO NOT USE
4. On circuit breaker panel 21VU - close circuit breaker 30FN3	- on left ECAM display unit the previous text disappears
5. On circuit breaker panel 21VU - open NAVIGATION/CAPT/EFIS/SGU1 circuit breaker - 30 FN1 (line 104 - F/4)	- a diagonal line appears on CAPT PFD and ND
6. On circuit breaker panel 21VU - open NAVIGATION F/O EFIS/SGU2 circuit breaker - 30 FN2 (line 104 - F/11)	- a diagonal line appears on F/O PFD and ND.
7. On panel 133VU close circuit breakers 2GB and 1GB	
8. On R instrument panel 406VU - press EFIS/SGU pushbutton switch	- SYS3 legend comes on - On L instrument panel 402VU F/O/3 legend comes on - F/O PFD and ND display their normal image.
9. On L instrument panel 402VU - press EFIS/SGU pushbutton switch	- SYS3 legend comes on

ACTION	RESULT
	- F/O/3 legend goes off - On R instrument panel 406VU . SYS3 legend goes off . CAPT/3 legend comes on - a diagonal line appears on F/O PFD and ND - CAPT PFD and ND display their normal image.
10. On R instrument panel 406VU - release EFIS/SGU pushbutton switch	- Nothing happens.
11. On circuit breaker panel 21VU - open NAVIGATION EFIS/SGU3 circuit breaker 30FN3	- a diagonal line appears on CAPT PFD and ND
12. On circuit breaker panel 21VU - close circuit breaker 30FN3	- CAPT PFD and ND display their normal image
13. On L instrument panel 402VU - release EFIS/SGU pushbutton switch	- SYS3 legend goes off - On R instrument panel 406VU CAPT/3 legend goes off - a diagonal line appears on CAPT PFD and ND.
14. On circuit breaker panel 21VU - close circuit breakers 30FN1 and 30FN2	- all PFDs and NDs display their normal image.

R **ON A/C 001-100,

(c)PFD/ND XFR

ACTION	RESULT
1. On glareshield, panel 413VU (412VU) - turn PFD knob to OFF position	Check that - CAPT (F/O) PFD goes off - PFD image appears on CAPT (F/O) ND in place of ND image
2. On L (R) instrument panel 402VU (406VU) - press PFD/ND XFR pushbutton switch	- The ON legend comes on - On ND, ND image reappears
- release PFD/ND XFR pushbutton switch	- The ON legend goes off - On ND, PFD image appears
3. On 413VU (412VU) - Turn PFD knob to mid position	- On PFD, PFD image reappears - On ND, ND image reappears.
4. On 402VU (406VU) - press PFD/ND XFR pushbutton switch	- The ON legend comes on - On CAPT (F/O) PFD and ND the displays are interverted. ND image on the PFD PFD image on the ND.
- release PFD/ND XFR pushbutton switch	- The ON legend goes off. - The displays return to normal ND image on the ND PFD image on the PFD.

(d)Close-up
1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Restore system and aircraft to normal operating condition.

R **ON A/C 101-200,

(c)Close-up
1 De-energize the aircraft electrical network (Ref. 24-41-00, P. Block 301).
2 Restore system and aircraft to normal operating condition.

1. Reason for the Job
Reposition all cathode ray tubes by swapping all display units from one position to another.

2. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure	
- 29-21-00, P. Block 301	Green Auxiliary Power
- 31-51-00, P. Block 501	ECAM System
- 34-71-00, P. Block 501	EFIS

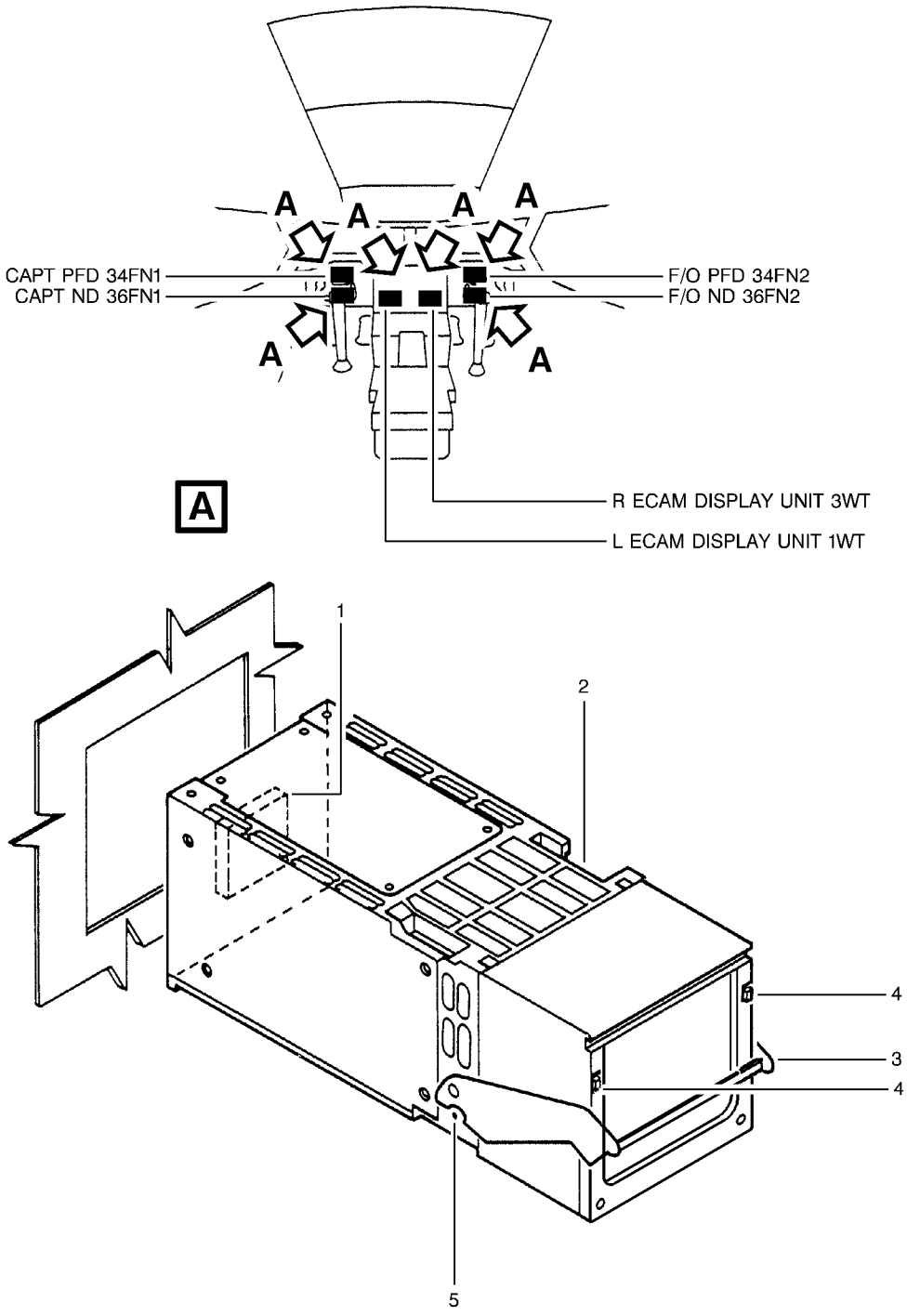
(Ref. Fig. 201)

3. Procedure
A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/CAPT/EFIS/PFD	35FN1	104/F 2
21VU	NAVIGATION/F/O/EFIS/PFD	35FN2	104/F13
21VU	NAVIGATION/CAPT/EFIS/ND	37FN1	104/F 1
21VU	NAVIGATION/F/O/EFIS/ND	37FN2	104/F14
21VU	ECAM/DISPLAY UNIT L	7WT	108/B 2
21VU	ECAM/DISPLAY UNIT R	8WT	108/B 3
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARESHLD	1LF	322/N76

NOTE : In order to get enough space for the removal/installation of the ND, the control columns have to be moved backward. Pressurize/depressurize Green hydraulic system (Ref. 29-21-00, P. Block 301).

B. Removal of CAPT ND
NOTE : If the operator takes advantage of a scheduled removal to do the swapping procedure, it is possible to start from any DU other than the CAPT PFD provided the swapping is achieved in the same direction (for example, the DUs moving counterclockwise as mentioned).
(1)Push in the two locking catches (4).
(2)If necessary, push up handle (3) to decrease load applied to locking catches (4) : handle falls to level of studs.
(3)Slowly and continuously lower handle (3) to bottom section of screen :
- at the same time, unit (2) moves out from panel by approx. 3 cm.
(4)Pull handle (3) found at removal point and disengage unit (2).



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Display Unit Swapping
Figure 201

(5)Remove unit (2).
(6)Put unit aside, and retain it to be installed as the last one of the six display units.

C. Removal of CAPT PFD
(1)Push in the two locking catches (4).
(2)If necessary, push up handle (3) to decrease load applied to locking catches (4) : handle falls to level of studs.
(3)Slowly and continuously lower handle (3) to bottom section of screen :
- at the same time, unit (2) moves out from panel by approx. 3 cm.
(4)Pull handle (3) found at removal point and disengage unit (2).
(5)Remove unit (2).

D. Installation of CAPT PFD in Place of CAPT ND
(1)Clean and inspect display unit interface and/or adjacent area.
(2)In housing, make certain that :
- ventilation air inlet is in correct condition (flexible seal installed and duct not blocked)
- locking studs and movable locking hooks are not damaged.
(3)Make certain that electrical connectors are clean and in correct condition.
(4)Install unit (2) in panel opening previously fitted with the ND just removed.
Fully move down handle (3) to bottom of screen.
(5)Push unit until locking studs touch movable locking hook (5) (at this time, face of unit must be out of panel by approx. 3 cm).
(6)Push the two sides of unit (2) to connect electrical connector (1).
Let handle (3) move up freely until it is at level of locking catches (4) (unit is now in line with panel).
(7)Slowly and continuously move handle (3) to its maximum up position.
In this position, the two locking catches (4) are locked under handle (3).

E. Removal of R ECAM Display Unit
(1)Push in the two locking catches (4).
(2)If necessary, push up handle (3) to decrease load applied to locking catches (4) : handle falls to level of studs.
(3)Slowly and continuously lower handle (3) to bottom section of screen :
- at the same time, unit (2) moves out from panel by approx. 3 cm.
(4)Pull handle (3) found at removal point and disengage unit (2).
(5)Remove unit (2).

F. Installation of R ECAM Display Unit in Place of CAPT PFD
(1)Clean and inspect display unit interface and/or adjacent area.
(2)In housing, make certain that :
- ventilation air inlet is in correct condition (flexible seal installed and duct not blocked)
- locking studs and movable locking hooks are not damaged.
(3)Make certain that electrical connectors are clean and in correct condition.
(4)Install unit (2) in panel opening previously fitted with the PFD

just removed.
Fully move down handle (3) to bottom of screen.
(5)Push unit until locking studs touch movable locking hook (5) (at this time, face of unit must be out of panel by approx. 3 cm).
(6)Push the two sides of unit (2) to connect electrical connector (1). Let handle (3) move up freely until it is at level of locking catches (4) (unit is now in line with panel).
(7)Slowly and continuously move handle (3) to its maximum up position. In this position, the two locking catches (4) are locked under handle (3).

G. Removal of F/O ND
(1)Push in the two locking catches (4).
(2)If necessary, push up handle (3) to decrease load applied to locking catches (4) : handle falls to level of studs.
(3)Slowly and continuously lower handle (3) to bottom section of screen :
- at the same time, unit (2) moves out from panel by approx. 3 cm.
(4)Pull handle (3) found at removal point and disengage unit (2).
(5)Remove unit (2).

H. Installation of F/O ND in Place of R ECAM Display Unit
(1)Clean and inspect display unit interface and/or adjacent area.
(2)In housing, make certain that :
- ventilation air inlet is in correct condition (flexible seal installed and duct not blocked)
- locking studs and movable locking hooks are not damaged.
(3)Make certain that electrical connectors are clean and in correct condition.
(4)Install unit (2) in panel opening previously fitted with the ECAM display unit just removed.
Fully move down handle (3) to bottom of screen.
(5)Push unit until locking studs touch movable locking hook (5) (at this time, face of unit must be out of panel by approx. 3 cm).
(6)Push the two sides of unit (2) to connect electrical connector (1). Let handle (3) move up freely until it is at level of locking catches (4) (unit is now in line with panel).
(7)Slowly and continuously move handle (3) to its maximum up position. In this position, the two locking catches (4) are locked under handle (3).

J. Removal of F/O PFD
(1)Push in the two locking catches (4).
(2)If necessary, push up handle (3) to decrease load applied to locking catches (4) : handle falls to level of studs.
(3)Slowly and continuously lower handle (3) to bottom section of screen :
- at the same time, unit (2) moves out from panel by approx. 3 cm.
(4)Pull handle (3) found at removal point and disengage unit (2).
(5)Remove unit (2).

K. Installation of F/O PFD in Place of F/O ND
(1)Clean and inspect display unit interface and/or adjacent area.

(2)In housing, make certain that :
- ventilation air inlet is in correct condition (flexible seal installed and duct not blocked)
- locking studs and movable locking hooks are not damaged.

(3)Make certain that electrical connectors are clean and in correct condition.
(4)Install unit (2) in panel opening previously fitted with the **ND** just removed.
Fully move down handle (3) to bottom of screen.
(5)Push unit until locking studs touch movable locking hook (5) (at this time, face of unit must be out of panel by approx. 3 cm).
(6)Push the two sides of unit (2) to connect electrical connector (1).
Let handle (3) move up freely until it is at level of locking catches (4) (unit is now in line with panel).
(7)Slowly and continuously move handle (3) to its maximum up position.
In this position, the two locking catches (4) are locked under handle (3).

L. Removal of L **ECAM** Display Unit
(1)Push in the two locking catches (4).
(2)If necessary, push up handle (3) to decrease load applied to locking catches (4) : handle falls to level of studs.
(3)Slowly and continuously lower handle (3) to bottom section of screen :
- at the same time, unit (2) moves out from panel by approx. 3 cm.

(4)Pull handle (3) found at removal point and disengage unit (2).
(5)Remove unit (2).

M. Installation of L **ECAM** Display Unit in Place of **F/O PFD**
(1)Clean and inspect display unit interface and/or adjacent area.
(2)In housing, make certain that :
- ventilation air inlet is in correct condition (flexible seal installed and duct not blocked)
- locking studs and movable locking hooks are not damaged.

(3)Make certain that electrical connectors are clean and in correct condition.
(4)Install unit (2) in panel opening previously fitted with the **PFD** just removed.
Fully move down handle (3) to bottom of screen.
(5)Push unit until locking studs touch movable locking hook (5) (at this time, face of unit must be out of panel by approx. 3 cm).
(6)Push the two sides of unit (2) to connect electrical connector (1).
Let handle (3) move up freely until it is at level of locking catches (4) (unit is now in line with panel).
(7)Slowly and continuously move handle (3) to its maximum up position.
In this position, the two locking catches (4) are locked under handle (3).

N. Installation of **CAPT ND** in Place of L **ECAM** Display Unit
(1)Clean and inspect display unit interface and/or adjacent area.
(2)In housing, make certain that :
- ventilation air inlet is in correct condition (flexible seal installed

and duct not blocked)
- locking studs and movable locking hooks are not damaged.

(3) Make certain that electrical connectors are clean and in correct condition.
(4) Install unit (2) in panel opening previously fitted with the ECAM display unit just removed.
Fully move down handle (3) to bottom of screen.
(5) Push unit until locking studs touch movable locking hook (5) (at this time, face of unit must be out of panel by approx. 3 cm).
(6) Push the two sides of unit (2) to connect electrical connector (1). Let handle (3) move up freely until it is at level of locking catches (4) (unit is now in line with panel).
(7) Slowly and continuously move handle (3) to its maximum up position. In this position, the two locking catches (4) are locked under handle (3).
(8) Remove safety clips and tags and close circuit breakers 35FN1, 35FN2, 37FN1, 37FN2, 7WT, 8WT and 1LF.

4. Test
A. Perform EFIS operational test (Ref. 34-71-00, P. Block 501, Para. A. EFIS/DISPLAYS Test and Para. E. Complementary Control Panel Test).
B. Perform operational test of ECAM system (Ref. 31-51-00, P. Block 501, Para. 1.G. ECAM/EFIS DISPLAYS Test).

5. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

EFIS CONTROL PANEL (42FN1, 42FN2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-71-00, P. Block 501	EFIS

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For CAPT EFIS control panel

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/CAPT/EFIS/CTL PNL	43FN1	104/F 3
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

(b)For F/O EFIS control panel

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/F/O/EFIS/CTL PNL	43FN2	104/F12
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

B. Removal

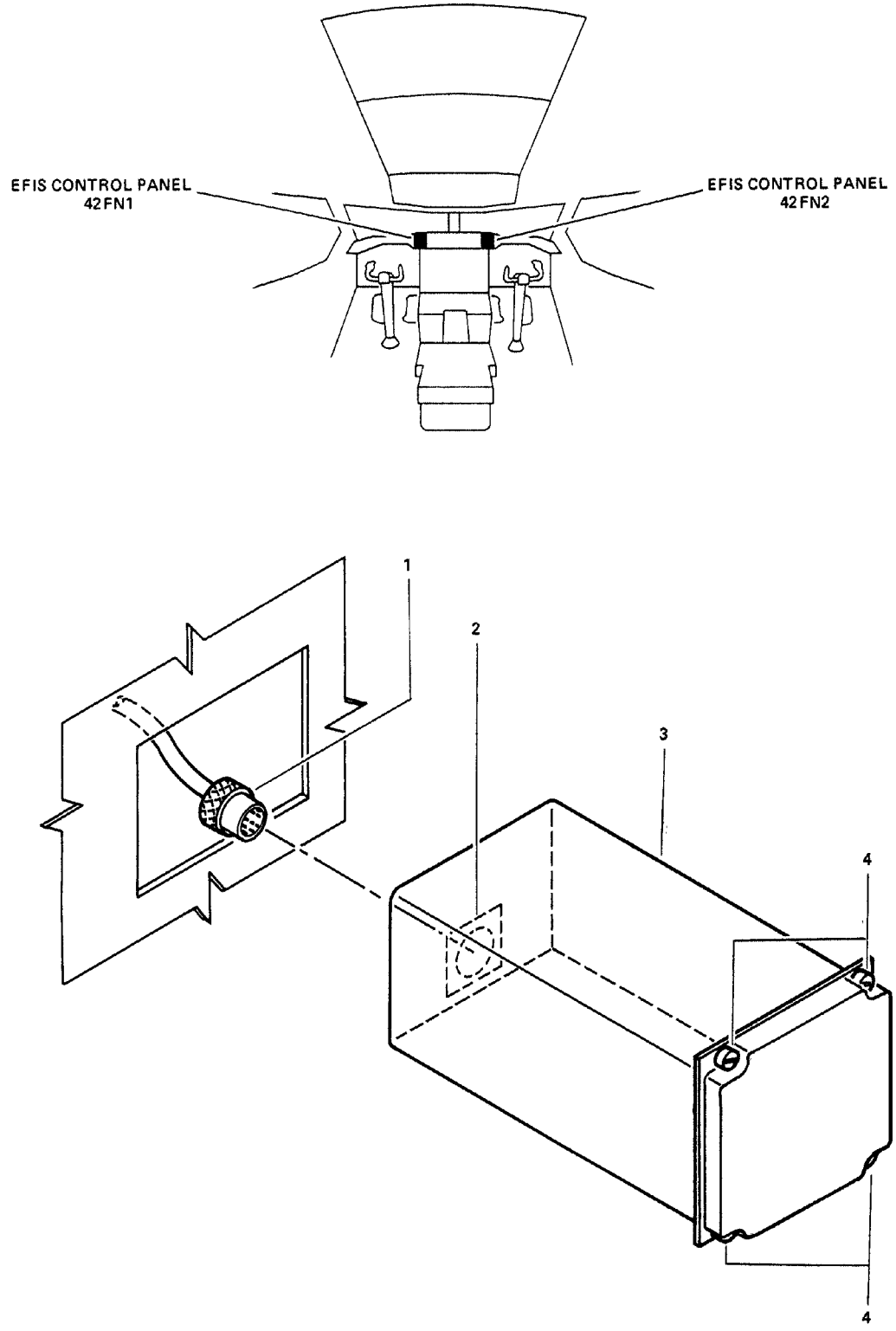
(1)Unscrew the four quick-release fasteners (4) on EFIS control panel (3).
(2)Remove EFIS control panel (3) from its housing.
(3)Disconnect and blank electrical connector (1).
(4)Blank EFIS control panel (3) receptacle (2).
(5)Remove EFIS control panel.

C. Installation

(1)Clean and inspect EFIS control panel (3) interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (1) and (2).
(3)Connect electrical connector (1) to EFIS control panel.
(4)Install EFIS control panel (3) in its housing.
(5)Tighten the four quick release fasteners (4).
(6)Remove safety clips and tags and close circuit breakers 43FN1, 43FN2 and 1LF.

D. Test

Carry out EFIS operational test (Ref. 34-71-00, P. Block 501, paragraph D. : EFIS control panel test).



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EFIS Control Panel
Figure 401

R

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

R 1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Caps
Referenced Procedure - 34-71-00, P. Block 501	EFIS

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers
(a)For EFIS SGU1

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/CAPT/EFIS/SGU1	30FN1	104/F 4

(b)For EFIS SGU2

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/F/O/EFIS/SGU2	30FN2	104/F11

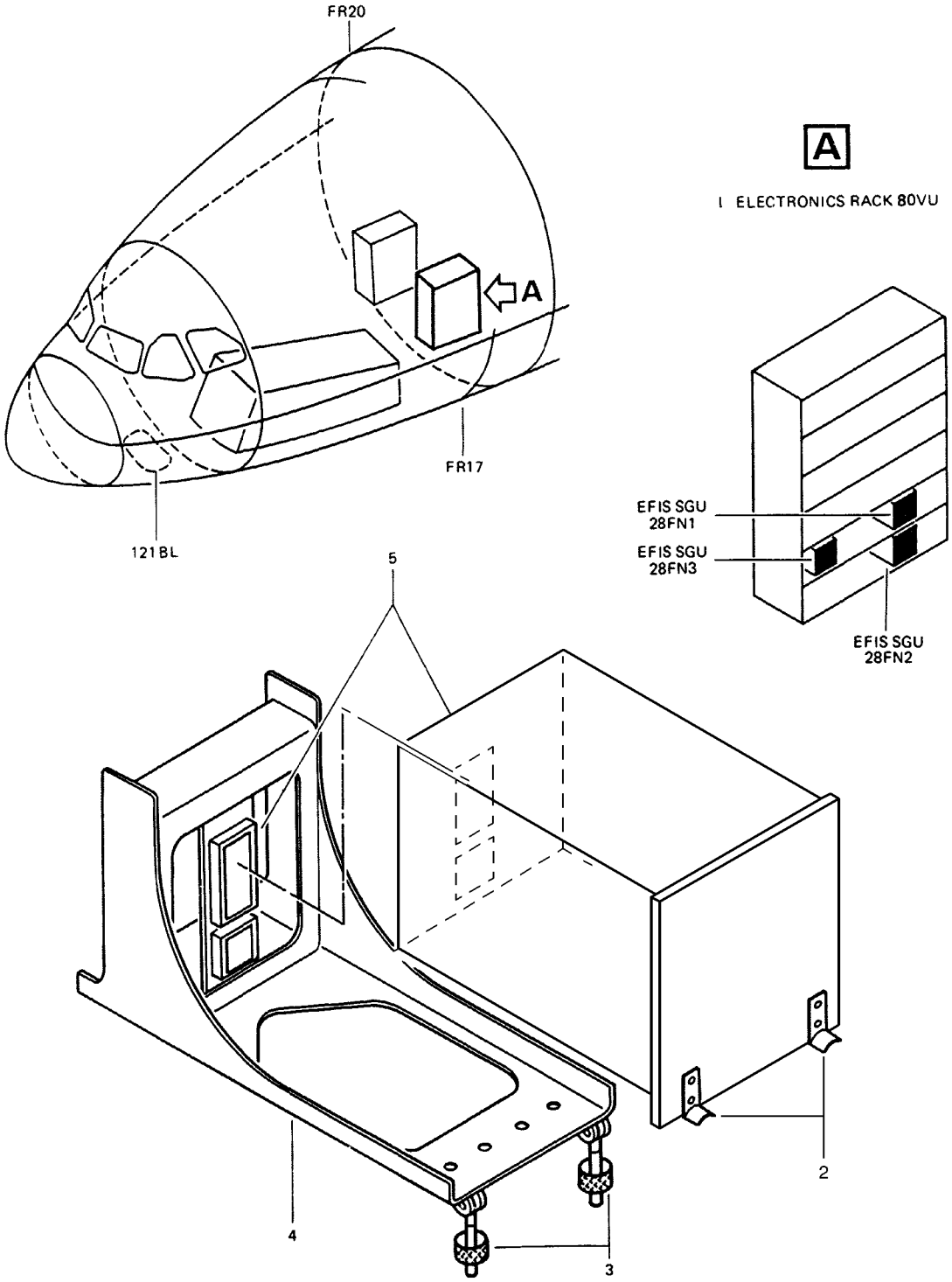
(c)For EFIS SGU3

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/EFIS/SGU3	30FN3	104/F 6

(2)Open access door 121BL and gain access to SGU to be removed.

B. Removal
(1)Unscrew knurled nuts (3) on face of rack (4) and tilt them downwards.
(2)Remove EFIS SGU (1) from rack (4)
(3)Blank electrical connectors (5)
(4)Remove EFIS SGU (1)

C. Installation
(1)Clean and inspect SGU interface and/or adjacent area.
(2)Remove blanking caps from electrical connectors (5).
(3)Check for correct condition of electrical connectors.
(4)Install EFIS SGU (1) in rack (4)
(5)Lift knurled nuts (3) into position on studs (2) and tighten.
(6)Remove safety clips and tags and close circuit breakers 30FN1,



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EFIS SGU
Figure 401

R

30FN2 and 30FN3.

D. Test
Perform EFIS operational test (Ref. 34-71-00, P. Block 501, para A : EFIS/DISPLAY Test and para B : EFIS/INPUTS Test).

E. Close-Up
(1)Make certain that working area is clean and clear of tools and miscellaneous items of equipment.
(2)Close access door 121BL.

PRIMARY FLIGHT DISPLAY 34FN1 (34FN2) - REMOVAL/INSTALLATION

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-71-00, P. Block 501	EFIS

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up

(1)Open, safety and tag the following circuit breakers :

(a)For PFD1 (34FN1)

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/CAPT/EFIS/PFD	35FN1	104/F 2
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

(b)For PFD2 (34FN2)

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/F/O/EFIS/PFD	35FN2	104/F13
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

B. Removal

(1)Simulatenously press both locking catches (4) towards screen.

(2)If necessary, release force applied to catches by pushing handle (3) upwards
- handle falls at catches level.

(3)Progressively move handle (3) down to screen lower section.
- simultaneously, unit is extracted from panel by approx. 3 cm. (1.1811 in.)

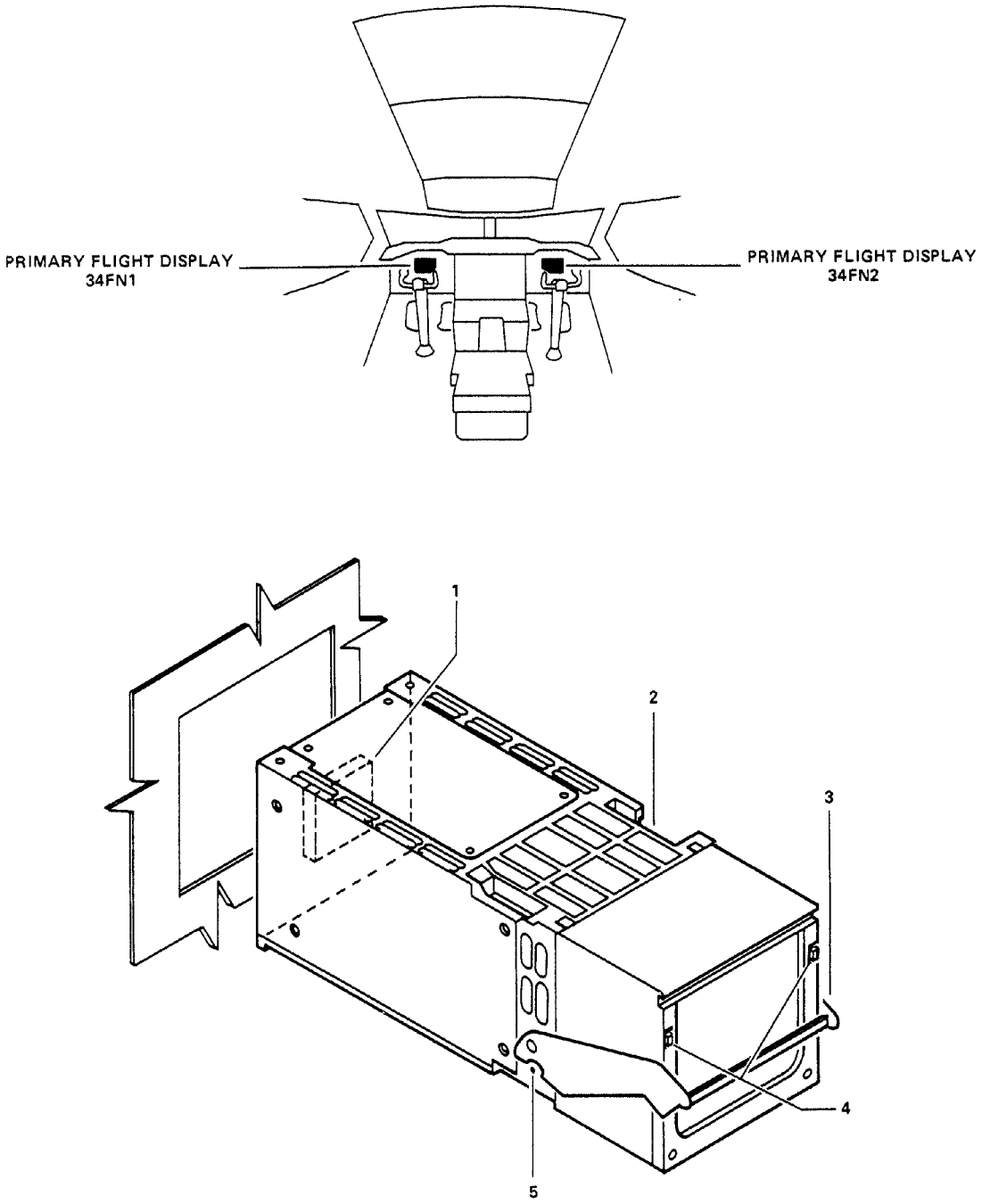
(4)Pull handle positioned at extraction point and remove unit (2).

(5)Blank rear connector (1) and protect screen. Immediately place unit in replacement unit packing.

C. Installation

(1)Clean and inspect primary flight display interface and/or adjacent area.

(2)In housing
- check for correct condition of ventilation air inlet (presence of interface flexible seal and no obstruction of duct)



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Primary Flight Display
Figure 401

- check on both sides that locking studs are not damaged.
- check for correct condition of connector.

(3)Remove blanking cap from connector (1)
(4)Position unit at opening in panel.
NOTE : Move handle FULLY downwards to screen lower section.
(5)Push unit until locking studs come into contact with movable locking hook (5). (Unit face protrudes then by approx. 3 cm with respect to panel). (1.1811 in.)
(6)While pushing on both sides of unit allow handle to move FREELY up to locking catches (4) level (unit face is then flush with panel).
(7)Progressively move handle to its maximum up position until locking catches are click-stopped and locked under handle.
(8)Remove safety clips and tags and close circuit breakers :
(a)For PFD1 : 35FN1 and 1LF
(b)For PFD2 : 35FN2 and 1LF.

D. Test
Perform EFIS operational test (Ref. 34-71-00, P. Block 501, para.A. : EFIS/DISPLAYS Test and para.E. : Complementary Control Panel Test).

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

R

1. Reason for the Job

The screen of each Display Unit must be completely free of finger marks, dust and rings.

For a multilayer anti-reflection coating, a perfectly clean surface has a reflection coefficient two or three times better than a surface soiled with finger marks.

2. Equipment and Materials

ITEM	DESIGNATION
A.Material No. 11-010	Isopropanol Alcohol (Ref. 20-31-00)
A.Material No. 11-020	Alglas Visial (Ref. 20-31-00)
R C.	Absorbent Surgical Cotton Wadding
R D.	Impregnated Screen Pad 2000
R E.	Optical Precision Pad
R F.	Sterile Gauze Pad

3. Procedure

R A. Cleaning of the Screen of the Display Unit

R CAUTION : BE VERY CAREFUL WHEN YOU CLEAN THE FRONT GLASS OF PFD'S. IT
R IS NOT POSSIBLE TO REPLACE THE GLASS. IF YOU CAUSE DAMAGE TO
R PFD'S, THE DAMAGE WILL BE PERMANENT.

R CAUTION : MAKE SURE THAT YOU OBEY THE INSTRUCTIONS IN THE CLEANING
R PROCEDURE THAT FOLLOWS. INCORRECT CLEANING CAN CAUSE DAMAGE TO
R THE ANTI-REFLECTIVE COATING.
R IT IS NOT PERMITTED TO USE TISSUES SUCH AS KLEENEX TISSUES. SUCH
R TISSUES CAN CAUSE LOCAL REMOVAL OF THE SURFACE TREATMENT, AND
R THUS HALOS OR SCRATCHES.
R ALWAYS APPLY THE CLEANING AGENT TO THE PAD AND NOT TO THE SCREEN.

R (1) Make an absorbent surgical cotton wadding or a sterile gauze pad or an optical precision pad moist with Isopropanol Alcohol (Material No. 11-010) or Algas Visial (Material No. 11-020) or use an impregnated screen pad 2000.

R (2) Move the moist wad (or pad) lightly across the surface of the screen (one time only).

R (3) If you find again marks or dust on the screen, do steps (1) and (2) again with a new piece of moist wad (or pad). Do these steps again until the screen is fully clean.

R NOTE : Use a new pad (or wad) each time to prevent scratches
R that can be caused by a dusty pad.

R (4) Dry the screen with a clean wad (or pad). To do this, move the clean wad (or pad) lightly across the surface of the screen (one time only).

R NOTE : We recommend to frequently clean the screen to remove
R finger marks or dust.

R 4. Close-up

R A. Make sure that the work area is clean and clear of tool(s) and other items.

1. Equipment and Materials

ITEM	DESIGNATION
A.	Circuit Breaker Safety Clips
B.	Blanking Plugs/Caps
Referenced Procedure - 34-71-00, P. Block 501	EFIS

(Ref. Fig. 401)

2. Procedure

A. Job Set-Up
(1)Open, safety and tag the following circuit breakers :
(a)For ND1 (36FN1)

PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/CAPT/EFIS/ND	37FN1	104/F 1
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

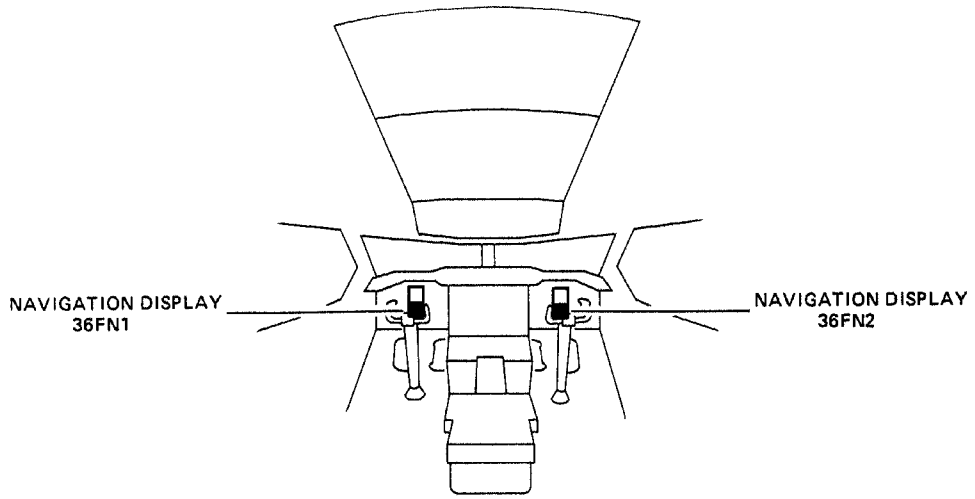
(b)For ND2 (36FN2)

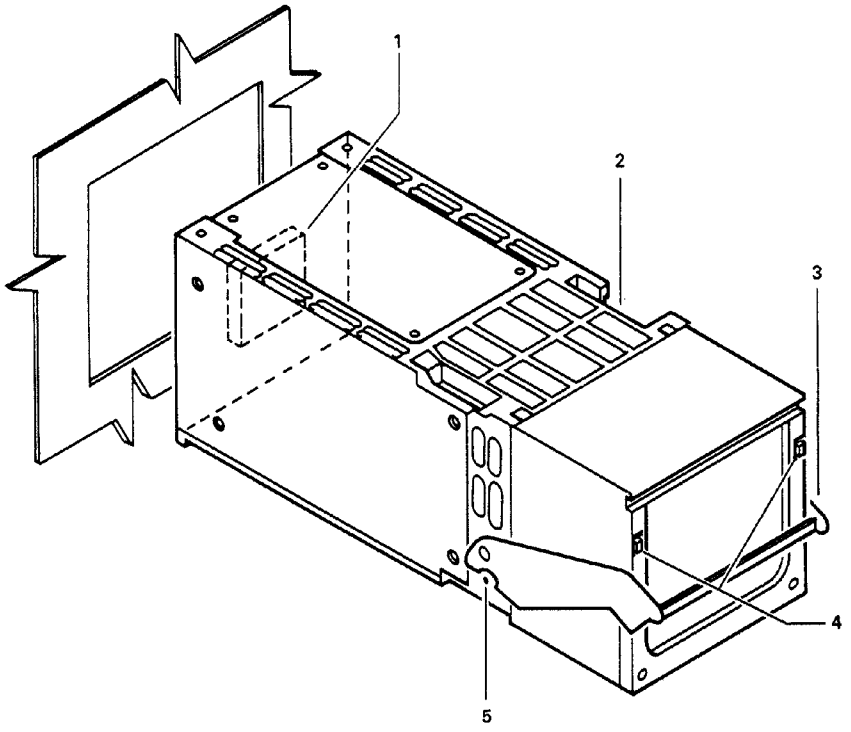
PANEL	SERVICE	IDENT.	LOCATION
21VU	NAVIGATION/F/O/EFIS/ND	37FN2	104/F14
132VU	LIGHTING/INTEGRAL LT/MAIN PNL AND GLARE SHLD	1LF	322/N76

NOTE : In order to get enough space for the removal/installation of the ND, the control columns have to be moved backward. Pressurize/depressurize Green hydraulic system (Ref. 29-21-00)

B. Removal
(1)Simultaneously press both locking catches (4) towards screen.
(2)If necessary, release force applied to catches by pushing handle (3) upwards
- handle falls at catches level.
(3)Progressively move handle (3) down to screen lower section.
- simultaneously unit is extracted from panel by approx. 3 cm.
(4)Pull handle positioned at extraction point and remove unit (2).
(5)Blank rear connector (1) and protect screen. Immediately place unit in replacement unit packing.

C. Installation
(1)Clean and inspect navigation display interface and/or adjacent area.
(2)In housing
- check for correct condition of ventilation air inlet (presence of





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Navigation Display
Figure 401

interface flexible seal and no obstruction of duct).
- check on both sides that locking studs are not damaged.
- check for correct condition of connector.

(3)Remove blanking cap from connector (1).
(4)Position unit at opening in panel.
NOTE : Move handle FULLY downwards to screen lower section.
(5)Push unit until locking studs come into contact with movable locking hook (5). (Unit face protrudes then by approx. 3 cm with respect to panel).
(6)While pushing on both sides of unit allow handle to move FREELY up to locking catches (4) level (Unit face is then flush with panel).
(7)Progressively move handle to its maximum up position until locking catches are click-stopped and locked under handle.
(8)Remove safety clips and tags and close circuit breakers :
(a)For ND1 : 37FN1 and 1LF
(b)For ND2 : 37FN2 and 1LF

D. Test
Perform EFIS operational test (Ref. 34-71-00, P. Block 501, para.A. : EFIS/DISPLAYS Test and para. E : Complementary Control Panel Test)

E. Close-Up
Make certain that working area is clean and clear of tools and miscellaneous items of equipment.

Refer to AMM 31-57-22, P. Block 701.